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(54) **DISPLAY DEVICE**

ANZEIGEVORRICHTUNG

DISPOSITIF D'AFFICHAGE

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- **PATENT ABSTRACTS OF JAPAN vol. 013, no. 561 (E-859), 13 December 1989 & JP 01 232694 A (JAPAN AVIATION ELECTRON IND LTD), 18 September 1989 -& JP 01 232694 A**
- **PATENT ABSTRACTS OF JAPAN vol. 013, no. 316 (P-900), 18 July 1989 & JP 01 086116 A (NIPPON MEKTRON LTD), 30 March 1989 -& JP 01 086116 A**
- **PATENT ABSTRACTS OF JAPAN vol. 005, no. 088 (P-065), 9 June 1981 & JP 56 035029 A (CANON INC), 7 April 1981**

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Description

FIELD OF INVENTION

5 [0001] The present invention relates to display devices, in particular thin picture display devices capable of providing the illusion of moving pictures. The present invention also relates to such display devices which are particularly economic to produce and which may also be disposable.

BACKGROUND

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[0002] Display devices capable of providing the illusion of moving pictures are well known, and include projectors (both cinematographical as well as tele-video), used typically in the cinema and in large tele-video displays; cathode ray tubes used extensively in Television sets and in computer display screens; liquid crystal displays (LCD's), used extensively in notebook and laptop computers; light-emitting diodes (LED's), used for very large displays; field emission displays and vacuum fluorescent displays among others.

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[0003] Prior art display devices are relatively complex items and are thus relatively expensive to manufacture. While LCD's for example have been steadily reducing in price over recent years, primarily due to the explosion in the demand for laptop, palmtop and notebook computers worldwide, they are still relatively expensive items costing between tens and hundreds of dollars to manufacture, and in some cases much more. Most certainly the screens used in such applications have a relatively long life, being generally serviceable and intended to be used repeatedly, and are thus never contemplated as disposable items in the sense of being used once or at most several times only, to be discarded after such limited use without significant economic loss. Therefore, display devices have not been incorporated in a host of many and varied applications in which they could provide an advantage since the costs heretofore associated with such prior art devices render their use in such applications totally uneconomic.

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[0004] For example, the packaging of consumer products has traditionally taken the form of a static visual image, printed onto a suitable packaging material, designed to enable a consumer to readily identify the product and manufacturer thereof, and to appeal to potential customers. The use of motion pictures in attracting the attention of potential customers to a given product is a very powerful marketing tool, and is used extensively in the form of tele-video advertising. However, the drawback in such advertising is that it does not generally occur at the point of sale, but rather when the potential customer is at home. While broadcasting tele-video advertisements in a store may attract potential customers to a particular product in some measure, customers do not in general tend to watch such televised advertisements while actually shopping. Further, tele-video advertising in a store does not necessarily overcome broadcast problems relating to the advertising of material, or material of interest, with respect to *all* goods simultaneously, or even regarding the goods in which a customer may be interested on any particular day. Product advertising on the product itself and by means of a display device capable of providing the illusion of moving pictures is herein considered to be a powerful advertising tool at the point of sale, and therefore potentially a very valuable marketing tool. However to be economically viable, such a display device has to be very inexpensive to manufacture.

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[0005] EP 764966 discloses a plasma display panel for achieving color expansion reproducibility and an improvement in contrast ratio. The plasma display panel includes color filters formed in stripes which are successively arranged on one surface of a front glass substrate, with interposing black matrixes between them. Sustaining electrodes are provided thereon and a dielectric layer and a protecting layer are provided. On a rear glass substrate barrier ribs are provided in an arrangement such that they face the respective black matrixes and thus the spaces between the barrier ribs facing respective color filters form cells. The cells are respectively provided with the sustaining electrodes falling at right angles with the address electrodes coated with fluorescent substances corresponding to the respective colors, and also sealed to hold discharge gas therein. A wave band selection filter for screening the light emitted from the discharge gas in the respective cells is provided on the other surface of the front glass substrate.

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[0006] Thus, it is an aim of the present invention to provide a picture display device capable of displaying moving pictures at very low cost.

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[0007] It is another aim of the present invention to provide a low-cost picture display device capable of displaying a series of images, one at a time, in any order desired by the user.

[0008] It is also an aim of the present invention to provide such a device which may be attached to the packaging of a very wide variety of products, or optionally which may be integral with the said packaging.

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[0009] In addition to on-product advertising, there are many and varied applications in which such a low-cost picture display device, in particular capable of providing moving pictures or at least a series of pictures, would be very advantageous.

[0010] For example, there are certain types of lottery tickets in general use in which the user has to rub off certain portions of the ticket to uncover a hidden message or characters. If the message or character matches a predetermined format, then the user is declared a winner. Such lottery tickets could take the form of a picture display device, in which

only, say, one or a series of pictures may be viewed. A user would activate the picture by actuating a switch, for example, and the picture that is then displayed is compared to the winning image format.

[0011] It is thus another aim of the present invention to provide a low-cost picture display device adapted for use as a lottery ticket.

[0012] Bill boards, of all sizes - some rather large - are used for advertising along the sides of streets and highways, and usually comprise a poster featuring a particular visual image and/or message. Some billboards are more sophisticated and enable up to 3 different images or messages to be displayed on the same bill board, by dividing the billboard into a series of parallel adjacent prismatic elements, triangular in transverse cross section and pivotable about a longitudinal axis. The prismatic elements can then be rotated about the pivot axes to display, in turn, each of the corresponding first, second and third faces of adjacent elements, thereby displaying one of three different visual images or messages in cycles. Low-cost picture display devices capable of providing moving images on a bill-board-sized display would thus enable the advertising of products, services or notices, for example, in the form of a large-scale tele-video presentation, perhaps similar to television or cinema commercials. Such a device, particularly if low-cost, would radically change the face of billboard advertising.

[0013] Another possible application of such a low-cost picture display device includes traffic and street signs. In particular, such a display device would be particularly advantageous where the nature of the message displayed by the street signs needs to be periodically changed, particularly cyclically. For example, on a street zone in which parking is only permitted on certain times of the day, such a display device may incorporate two images, say, one denoting the area as a parking zone, and the other image denoting a no-parking zone. A chronometer connected to the device enables either one or the other sign to be displayed at the appropriate times.

[0014] It is thus another aim of the present invention to provide a picture display device, in particular a low-cost picture device, adapted for use as an outdoors bill-board for advertising, for use as traffic/street signs, as well as for other related uses.

[0015] Postcards and greeting cards, such as birthday cards for example, are also traditionally static visual images printed onto a stiff substrate. Postcards and greeting cards adapted to incorporate picture display devices capable of providing moving images on the cards at low cost would have a radical impact in the postcard and greeting card market.

[0016] It is thus another aim of the present invention to provide a low-cost picture display device adapted for use as postcards and as greeting cards of every variety, including personal and seasonal greeting cards.

[0017] Similarly low-cost picture display devices capable of providing moving images, or at least a series of static images, could provide a very attractive alternative to displaying material now commonly found in books, and in particular comics, magazines and brochures (e.g., travel brochures, motorcar brochures etc.). Such devices could optionally display images or information as a moving picture, or optionally as a series of images, appearing one at a time as desired by the user, specially when the images represent printed matter as, for example, the pages of a book.

[0018] It is thus another aim of the present invention to provide a low-cost picture display device adapted for use to display material commonly found in books, comics, magazines, brochures and other printed matter.

[0019] Another possible application of low-cost picture display devices capable of providing moving images is as a means of providing easy-to-follow instructions. For example, instructions on how to assemble an item of furniture could be incorporated into such a device as a series of images, in which each image, or a set of images, represents a different stage in the assembly. Each instruction can then be viewed by the user at will.

[0020] It is thus another aim of the present invention to provide a low-cost picture display device adapted for use as an instruction manual.

[0021] It is also another aim of the present invention to provide a picture display device adapted for displaying video images, including for example movies. In particular, it is an aim of the present invention to provide a low-cost picture display device for displaying said video images.

[0022] It is also another aim of the present invention to provide a picture display device adapted for displaying computer generated images. It is also an aim of the present invention to provide a low-cost picture display device for displaying computer generated images. In particular, it is also an aim of the present invention to provide a picture display screen capable of being used in conjunction with computers, including desk-top, lap-top, notebook and palmtop computers.

[0023] It is also another aim of the present invention to provide such low-cost picture devices which are disposable, particularly in an environment-friendly manner.

[0024] The above aims of the present invention are achieved with a picture display device as set forth in claim 1.

[0025] The cells themselves comprise configurations which are relatively simple and inexpensive to manufacture. By selectively choosing some cells to change colour at given times, a sequence of images, or the illusion of a moving picture may be created on the device. The device may thus be operatively connected to a suitable computer to operate as a computer screen or to a television/video system to operate as a viewing screen. Alternatively, the device may be adapted to display still and/or moving images in a very cost-effective manner by connecting the chosen colour cells for each "picture frame" or image to the suitable electrical power source by means of a simple frame circuit board which

comprises a unique circuit to connect the power source to the chosen cells. The device thus comprises a plurality of frame circuit boards, each frame circuit board providing all the necessary connections between the power source and the chosen cells of the device per frame. The power source can then be connected to each frame circuit board at will by the user, thereby providing a series of still images. Alternatively, a sequencing switch may be used to connect each of the frame circuit boards to the power source in a predetermined sequence and at a predetermined rate to enable the illusion of a moving image to be provided. The substrate may be flexible and thus enable the device to be particularly adaptable to being used in connection with product packaging such as cartons, bottles and the like. Alternatively, the substrate may also be rigid or semi rigid, enabling the device to be particularly adaptable for use in connection with such uses as computer screens, bill-boards and the like.

[0026] Also disclosed herein is the use of frame circuit boards as a simple and inexpensive method of connecting a power source to a picture display device.

[0027] Also disclosed are sequencing switches that enable connections between at least one electrical conductor and each of a plurality of conductors to be effected sequentially at a variable rate and in a cost effective manner, particularly adaptable to be used in printed circuits and microcircuits. In particular, the present invention relates to sequencing switch means capable of interconnecting a power source to each one of a plurality of frame circuit boards of said device.

BRIEF DESCRIPTION OF FIGURES

[0028]

Figure 1 illustrates in perspective view a first disclosed colour cell.

Figure 2 illustrates in exploded perspective view a colour cell according to a preferred embodiment of the present invention.

Figure 3 illustrates schematically the preferred embodiment of a display device comprising a plurality of colour cells as in Figures 1 and/or 2, operatively connected to a power source via a suitable microprocessor.

Figure 4 illustrates in partial cutaway perspective view of a second disclosed colour cell.

Figures 5(a) to 5(d) illustrate the colour cell of Figure 4 in top view when electrically disconnected from any electrical power source (Figure 5 (a)) and when connected to an electrical power source (Figure 5 (b)), and in corresponding side cross-sectional views (Figure 5 (c) and Figure 5 (d), respectively).

Figure 6 illustrates in partial cutaway perspective view of a third disclosed colour cell.

Figures 7(a) to 7(d) illustrate the colour cell of Figure 6 in top view when electrically disconnected from any electrical power source (Figure 7 (a)) and when connected to an electrical power source (Figure 7 (b)), and in corresponding side cross-sectional views (Figure 7 (c) and Figure 7 (d), respectively).

Figure 8 illustrates in partial cutaway perspective view of a fourth disclosed colour cell.

Figures 9(a) to 9(d) illustrate the colour cell of Figure 8 in top view when electrically disconnected from any electrical power source (Figure 9 (a)) and when connected to an electrical power source (Figure 9 (b)), and in corresponding side cross-sectional views (Figure 9 (c) and Figure 9 (d), respectively).

Figures 10(a) and 10(b) illustrate in top view and in side cross-sectional side view, respectively of a fifth disclosed colour cell.

Figure 11(a) to 11(d) illustrate the colour cell of Figure 10 in top view when electrically disconnected from any electrical power source (Figure 11 (a)) and when connected to an electrical power source (Figure 11 (b)), and in corresponding side cross-sectional views (Figure 11 (c) and Figure 11 (d), respectively).

- Figure 12 illustrates in side cross-sectional side view of a sixth disclosed colour cell.
- Figures 13 (a) to 13(d) illustrate the colour cell of Figure 12 in top view when electrically disconnected from any electrical power source (Figure 13 (a)) and when connected to an electrical power source (Figure 13 (b)), and in corresponding side cross-sectional views (Figure 13 (c) and Figure 13 (d), respectively).
- Figure 14 illustrates in partial cutaway perspective view of a seventh disclosed colour cell.
- Figures 15(a) to 15(d) illustrate the colour cell of Figure 14 in top view when electrically disconnected from any electrical power source (Figure 15 (a)) and when connected to an electrical power source (Figure 15 (b)), and in corresponding side cross-sectional views (Figure 15 (c) and Figure 15 (d), respectively).
- Figure 16 illustrates in perspective view of an eighth disclosed colour cell.
- Figure 17 illustrates schematically one embodiment of a display device comprising a plurality of colour cells illustrated in any one of in Figures 1, 2 and 4 to 16, operatively connected to a power source via sequencing means and a plurality of frame circuit boards.
- Figure 18 illustrates schematically another embodiment of a display device comprising a plurality of colour cells illustrated in any one of in Figures 1, 2 and 4 to 16, operatively connected to a power source via sequencing means and a plurality of frame circuit boards.
- Figure 19 illustrates a first disclosed sequencing means of Figures 17 and 18, in plan view (Figure 19(a)) and cross-sectional view (Figure 19(b)) taken along X-X.
- Figure 20 illustrates a second disclosed sequencing means of Figures 17, and 18, in plan view (Figure 20(a)) and cross-sectional view (Figure 20(b)) taken along Y-Y.
- Figure 21 illustrates a third embodiment of the sequencing means of Figures 17 and 18, in plan view (Figure 21 (a)) and cross-sectional view taken along Z-Z when a bimetallic strip is connected to an electrical power source (Figure 21 (b)) and when disconnected from same (Figure 21 (c)).
- Figure 22 illustrates a fourth embodiment of the sequencing means of Figures 17 and 18, in plan view (Figure 22 (a)) and cross-sectional view taken along U-U when a piezoelectric element is connected to an electrical power source (Figure 22 (b)) and when disconnected from same (Figure 22 (c)).

DESCRIPTION

[0029] The present invention is defined by the claims, the contents of which are to be read as included within the disclosure of the specification, and will now be described by way of example with reference to the accompanying Figures.

[0030] The present invention relates to picture display devices, in particular such devices capable of providing the illusion of moving pictures. The display devices of the present invention may be of substantially any size and shape, comprising a plurality of colour cells carried on a suitable substrate. Each of the colour cells is capable of exhibiting a change in its external colour and/or emitting electromagnetic energy at least in the form of visible light, either as a direct or indirect result of the passage of a suitable electrical current through the cell and/or the application of a suitable voltage to the cell.

[0031] The term "colour change" herein relates to a change from a colour to colourless (i.e., transparent), and also from colourless to a colour, as well as from one colour to another colour.

[0032] In particular, the preferred embodiment relates to such picture display devices which are particularly low cost items to manufacture.

[0033] Further, the display device of the preferred embodiment is preferably made from materials that are recyclable, particularly in an environmentally-friendly manner.

[0034] Also disclosed herein is a picture display device comprising a suitable substrate carrying a plurality of cells

wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour and/or of emitting electromagnetic energy at least in the form of visible light, each said colour cell comprising:-

5 luminescent means characterised in enabling said cell to exhibit a colour change from said first colour to said second colour and/or in enabling said cell to emit electromagnetic energy at least in the form of visible light in correlation to the application of electrical current and/or voltage to the said cell;

suitable electrical connections electrically connectable to a suitable electrical power supply and adapted to provide said colour cell with a suitable electrical current and/or voltage;

10 said device characterised in being substantially disposable.

[0035] The term "disposable", in the present application means that the display devices are designed such as to be able to be thrown away after one or more uses with only negligible loss.

15 [0036] The colour cells disclosed herein are considered as being of relatively small size, corresponding roughly in size to a television/monitor screen pixel (i.e., approximately 0.2mm), or preferably a fraction thereof. Nonetheless, cell size is not a limitation, and in fact, the cells can be considerably larger, several tens of centimeters across or far larger, for example, depending primarily on the actual application, the resolution required, and on the expected viewing distance from the observer to the device itself. Thus, in applications such as product advertising on the product packaging itself, such as for example a cereal packet, the device may be relatively small, perhaps half the size of one of the large faces of the packet for example, and the individual colour cells may be of a size in the order of that of regular television/monitor screen pixels. For product advertising such as on a large bill-board posted along highways, for example, each cell may be considerably larger, though a large cell may alternatively be made up of a plurality of smaller cells which are operated as a unit.

20 [0037] Also disclosed is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of emitting electromagnetic energy at least in the form of visible light, each said colour cell comprising:-

at least one pair of electrodes comprising a lower electrode comprised on said substrate and an upper electrode superposed and distanced from said lower electrode;

said at least one pair of electrodes capable of being electrically connected to at least one suitable electrical power source capable of providing at least a predetermined voltage and/or current between said upper electrode and said lower electrode of said at least one pair of electrodes;

35 at least one dielectric layer comprised of suitable dielectric material disposed intermediate said upper electrode and said lower electrode of said at least one pair of electrodes;

40 wherein said dielectric layer comprises at least one luminescent layer of luminescent material substantially parallel to and in electrical contact with at least one of said upper electrode and said lower electrode of said at least one pair of electrodes, said at least one luminescent layer being capable of emitting electromagnetic energy at least in the form of visible light in response to the establishment of said predetermined voltage and/or current between said upper electrode and said lower electrode of said at least one pair of electrodes, wherein said emission of said visible light is of sufficient intensity as to be capable of being observed from the exterior of said colour cell.

45 [0038] The said suitable electrical connections comprises an electrically heatable base comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said base to a suitable electrical power source, said base capable of being electrically heated at least from a first temperature to at least a second temperature in response to the supply of a predetermined voltage and/or current thereto; and furthermore, the said colour change and/or luminescent means comprises thermally responsive colour change means in thermal contact with said base, said colour change means enabling said cell to exhibit a colour change from said first colour to said second colour in response to said temperature change of the said base from said first temperature to said at least second temperature.

[0039] With reference to Figures 1 and 2, the display device, generally designated (10) comprises a suitable substrate (20) carrying a plurality of colour cells, designated (15) and (15A).

55 [0040] The substrate (20) is typically made from a non-conducting material, but may be made from a conducting or semi-conducting material having a layer of insulating material between the substrate and the cell. Typically, the substrate (20) is substantially flexible, but may also be substantially rigid or semi rigid, depending on the desired physical characteristics and application, and may thus comprise, for example; any one of the following materials:- PVC, poly-

propylene, nylon, ABS, polyethylene, and silicon, among others. In each of the embodiments described herein, each colour cell is electrically insulated from adjacent colour cells. Thus, at least the corresponding electrically conducting elements of adjacent colour cells are insulated one from another. Such insulation may be achieved by means of an insulating material placed between corresponding or adjacent electrically conducting elements of adjacent colour cells, or alternatively by means of a non-conducting space existing between at least corresponding or adjacent electrically conducting elements of adjacent colour cells.

[0041] Thus, and with reference to figure 1, there is disclosed a picture display device (10) comprising a suitable substrate (20) carrying a plurality of colour cells (15), wherein each of the colour cells is capable of emitting electromagnetic energy at least in the form of visible light, said emission being correlated to the application of a predetermined electrical voltage across the colour cell (15), or alternatively to the passage of a predetermined current therethrough. This predetermined voltage (or current) is the threshold voltage (or current, respectively) for the luminescent layer hereinafter described, and no significant emission of light occurs at voltages (or currents, respectively) below this. Each colour cell (15) of this embodiment comprises at least one pair of substantially parallel and preferably substantially flat and thin electrodes (23), comprising a lower electrode (24) comprised on said substrate (20) and an upper electrode (22) superposed over and distanced from said lower electrode (24). The said at least one pair of electrodes (23) is capable of being electrically connected, preferably by means of suitable conductors, (32) and (34), respectively, to at least one suitable electrical power source, which power source is capable of providing at least a predetermined voltage (Vp), and/or a suitable predetermined current, between said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes (23). Adjacent upper electrodes (22) of adjacent cells (15) are electrically insulated one from another, as are adjacent lower electrodes (24) of adjacent cells, typically by means of suitable insulating material or a suitable gap between adjacent electrodes or in any other suitable manner. The colour cell (15) further comprises at least one dielectric layer (19) comprised of suitable dielectric material, and the dielectric layer (19) is disposed intermediate said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes (23). While the pair of electrodes (23) are discretely defined for each cell (15), the dielectric layer (19), being essentially an insulating layer between the pair of electrodes (23), can be contiguous across the whole or part of the display device (10), as desired. The said dielectric layer (19) comprises at least one luminescent layer (17) of luminescent material substantially parallel to and in electrical contact with at least one of said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes (23). Thus, the luminescent layer (17) may be sandwiched between the upper electrode (22) and the dielectric layer (19) or alternatively between the lower electrode (24) and the dielectric layer (19). In any case, the luminescent layer (17) may alternatively be in the form of a contiguous layer across part or all of the device (10), or alternatively in the form of a single or a plurality of segments comprising an area similar to the plan area of the upper electrode (22) or lower electrode (24), and in corresponding alignment therewith. The said luminescent layer (17) is capable of emitting electromagnetic energy at least in the form of visible light in response to the establishment of said predetermined voltage (Vp) between said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes (24). Typically, the threshold value for the voltage between the electrodes is in the range of from about 105V to 110V in order for the luminescent layer (17) to emit visible light, and thus the value of said predetermined voltage (Vp) is likewise in the range of from about 105V to 110V, though (Vp) can be greater than 110V or smaller than 105V, according to the properties of the luminescent material comprising the said luminescent layer (17). The said emission of said visible light is of sufficient intensity such as to be capable of being observed from the exterior of said colour cell (15), and thus, there is an open optical path from the said luminescent layer (17) to the exterior of the cell (15). In other words, at least the said upper electrode (22) of said at least one pair of electrodes (23) is in optical communication with said luminescent layer (17), e.g., the said upper electrode (22) is essentially transparent; and similarly, the dielectric layer (19) is also in optical communication with said luminescent layer (17) and the upper electrode (22), e.g., the dielectric layer (19) is also essentially transparent, when the said dielectric layer (19) is sandwiched between the luminescent layer (17) and the upper electrode (22).

[0042] Optionally, the said luminescent layer (17) is made from a material having luminescent properties such that the emission of said visible light by said cell (15) ceases in correlation with the voltage between said upper electrode and said lower electrode of said at least one pair of electrodes falling to substantially below a predetermined voltage threshold, typically said predetermined voltage (Vp). Thus, the cell (15) is only capable of emitting visible light when a voltage potential of (Vp) or greater is applied between the pair of electrodes (23), and ceases to emit when the voltage drops to below (Vp). As such the cell (15) is able to respond quickly to changes in the voltage applied thereto, and therefore to changes in the correspond part of the image being displayed by the device (10). Some types of cells (15) may operate optionally or additionally on the basis of an electrical current threshold, *mutatis mutandis*.

[0043] Alternatively, the said luminescent layer (17) is made from a material having luminescent properties such that the emission of said visible light by said cell (17) endures for a period of time, typically with decaying intensity, after the voltage between said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes (23) falls to substantially below a predetermined voltage threshold, typically, said predetermined voltage (Vp). Thus, even though a voltage of (Vp) is required to initialise emission of light by the cell (15), emission persists for a limited time

after the voltage is removed or significantly lowered, and this effect is also known as "afterglow". Thus, the cell (15) enables light to be emitted for longer than the time for which the predetermined voltage (V_p) is applied thereto, and the actual duration of the afterglow may be determined, for example, by the specific properties of the luminescent material, as well as other factors including the thickness of the luminescent layer (17) and the magnitude of the voltage and/or current applied thereto. One important advantage of the afterglow effect in the context of said display device (10) is that it reduces or avoids the necessity of having to refresh any particular pixel, or group of pixels, which needs to be in activated mode for extended periods. In some applications, only a small percentage of pixels in a screen need to be activated/deactivated from frame to frame in the course of displaying a moving image, the remaining pixels requiring to continue as activated or as deactivated. Thus, in video movies, computer games, etc., most pixels need to continue in either the activated or deactivated mode unchanged from frame to frame, though not the same pixels necessarily need to change mode with every subsequent new frame. Normally, even the pixels which preserve their activated mode from frame to frame also need to be refreshed from frame to frame, otherwise they will become deactivated through the lack of voltage and/or current being provided to the corresponding colour cells, and thus all of the cells which need to be in activated mode for each frame need to be activated for the frame. This results in a great deal of memory being required to define each frame, when a microprocessor (19) is used to control the sequencing of images, as described hereinbelow, for example. Cells (15) comprising a luminescent layer (17) capable of providing afterglow for a period of time T are therefore able to perform like corresponding "non-afterglow" colour cells (15) while only needing to be activated about $1/T$ as often to provide the same effect. Thus, since the precise duty of any cell (15) in the device (10) can be predetermined for any given application, then, by providing cells (15) capable of providing afterglow at locations where the cells are required to remain activated for extended periods saves the corresponding memory space which would otherwise be required to reactivate a "non-afterglow" colour cell continuously during the same period. However, since in many applications all the pixels will eventually change their activated/deactivated mode, the device (10) may be advantageously divided into a number of pairs of, say adjacent, cells (15), in which one cell (15) of each pair is capable of providing afterglow, while the other is not. Alternatively, the device may comprise colour cells (15A) with nested luminescent layers (17A) and (17B), in which one thereof is capable of providing afterglow, according to the second aspect of the preferred embodiment of the present invention as hereinafter described. Thus, at every location of the display (10) the cell capable of providing afterglow is activated as required to maintain a pixel of an image activated for extended periods, while the adjacent or nested cell, which doesn't provide afterglow, is activated when substantially rapid changes in the activation/deactivation mode of the corresponding pixel are imminent or required. Some types of cells (15) may operate optionally or additionally on the basis of an electrical current threshold, *mutatis mutandis*.

[0044] Typically, said luminescent layer (17) comprises a suitable luminescent and/or phosphorescent material, such as, for example, zinc sulphide activated with silver or copper, or alternatively zinc silicate activated with manganese, among others.

[0045] The luminescent material of the said luminescent layer (17) may be chosen such that the visible light emitted by said cell (15) is of a wavelength corresponding to that of a predetermined one of the three primary colours, i.e., red, green or blue, or any other suitable colour.

[0046] Alternatively, said luminescent layer (17) may be chosen such that the visible light emitted by said cell (15) is substantially white light. Optionally, the cell (15) further comprises a filter layer (16) comprising a suitable optical filter superposed over said upper electrode (22) of said at least one pair of electrodes (23), said optical filter layer (16) adapted to enable the visible light emitted by said cell (15) to be of a predetermined colour, preferably one of the primary colours red, green or blue. Thus, if the said luminescent layer (17) emits substantially white light, then by providing a red, green or blue filter layer (16), the emitted light is correspondingly filtered to red, green or blue, respectively.

[0047] The said device (10) may then be conveniently arranged such that the colour cells (15) are divided into clusters of three cells (15) each, a "red" cell, a "green" cell and a "blue" cell, wherein the light emitted by the said luminescent layer (17) is respectively red, green and blue. In this manner, a range of colours may be perceived to be emitted from the cluster of cells (15), according to the combination of cells (15) in the cluster that are activated, i.e., that are emitting light, at any one time. The greater the number of cells (15), or such groups of red, green and blue cells, that represent each pixel of the image, the greater the number of potential colours that may be displayed.

[0048] The preferred embodiment is shown in Figure 2, and shows a colour cell (15A) for a picture display device comprising a colour cell (15A), comprising a first said luminescent layer (17A) intermediate a first said pair of electrodes (23A), wherein the first luminescent layer (17A) is such that the emission of said visible light by said cell (15A) ceases in correlation with the said voltage between the upper electrode (22A) and the lower electrode (24A) of said first pair of electrodes (23A) falls to substantially below a predetermined voltage threshold, i.e. (V_p), as hereinbefore described, *mutatis mutandis*. The cell (15A) further comprises a second said luminescent layer (17B) intermediate a second said pair of electrodes (23B), wherein said second luminescent layer (17B) is such that the emission of said visible light by said cell (15A) endures for a period of time after the said voltage between the upper electrode (22B) and the lower electrode (24B) of said second pair of electrodes (23B) falls to substantially below a predetermined voltage threshold,

i.e. (Vp), as hereinbefore described, *mutatis mutandis*. Again, since the dielectric layer (19), is essentially an electrically insulating layer between the first pair of electrodes (23A) as well as between the second pair of electrodes (23B), the said dielectric layer (19) may be contiguous across the whole or part of the cell (15A) or of the display device (10), as desired.

[0049] Preferably, the said first upper electrode (22A) and said first lower electrode (24A) are substantially thin and flat, and are parallel one to the other, and the said first pair of electrodes (23A) is capable of being electrically connected, preferably by means of suitable conductors, (32A) and (34A), respectively, to at least one suitable electrical power source, which power source is capable of providing at least a predetermined voltage (Vp) between said first upper electrode (22A) and said lower electrode (24A) of said first pair of electrodes (23A).

[0050] Similarly, the said second upper electrode (22B) and said second lower electrode (24B) are substantially thin and flat, and are parallel one to the other, and the said second pair of electrodes (23B) is capable of being electrically connected, preferably by means of suitable conductors, (32B) and (34B), respectively, to at least one suitable electrical power source, which power source may or may not be the power source providing power to the first pair of electrodes (23A), and is capable of providing at least a predetermined voltage (Vp) between said second upper electrode (22B) and said lower electrode (24B) of said second pair of electrodes (23B).

[0051] Further, the said first upper electrode (22A) and adjacent said second upper electrode (22B) are electrically insulated from each other and from the corresponding upper electrodes of adjacent colour cells, and likewise the said first lower electrode (24A) and the adjacent said second lower electrode (24B) are also electrically insulated from each other and from the corresponding lower electrodes of adjacent colour cells. Such electrical insulation may be accomplished by the provision of suitable insulating material or a suitable gap between adjacent electrodes, or in any other suitable manner.

[0052] Preferably, in the second aspect of the preferred embodiment, said first pair of electrodes (23A) and corresponding said first luminescent layer (17A) disposed therebetween is nested within said second pair of electrodes (23B) and corresponding said second luminescent layer (17B) disposed therebetween. In other words, the first upper electrode (22A) of the first pair of electrodes (23A) is preferably nested within the second upper electrode (22B) of the second pair of electrodes (23B); the first lower electrode (24A) of the first pair of electrodes (23A) is preferably nested within the second lower electrode (24B) of the second pair of electrodes (23B); the first luminescent layer (17A) intermediate the first pair of electrodes (23A) is preferably nested within the second luminescent layer (17B) intermediate the second pair of electrodes (23B).

[0053] Optionally, the said first luminescent layer (17A) is substantially disc-shaped, and the said second luminescent layer (17B) is substantially annular-shaped. Alternatively, the said first luminescent layer (17A) is substantially rectangular-shaped, and the said second luminescent layer (17B) is in the form of a strip running along the periphery of the first luminescent layer (17A). Typically, the upper and lower electrodes of the first and second pairs of electrodes (23A) and (23B) respectively, are shaped in a similar manner to the corresponding luminescent layer (17A), (17B), respectively, with the proviso that the outer, second upper electrode (22B) and second lower electrode (24B) each optionally comprise a narrow gap to allow passage of the said conductors (32A) and (34A) from the inner first upper electrode (22A) and first lower electrode (24A) to outside of the cell (15A). Alternatively, the gap may be replaced by providing insulating material between the said conductors (32A) and (34A) and the second upper electrode (22B) and second lower electrode (24B), respectively.

[0054] The luminescent material of the said first and second luminescent layers (17A), (17B) respectively, may each be chosen such that the visible light emitted by said cell (15A) from each luminescent layer is of a wavelength corresponding to that of a predetermined one of the three primary colours, i.e., red, green or blue, or any other suitable colour, or alternatively that of white light. Preferably, the luminescent material of both the said first and the second luminescent layers (17A) and (17B), respectively, are chosen such that the visible light emitted by both luminescent layers (17A) and (17B) are of substantially equal wavelength, though alternatively the emitted light from each of the said first and the second luminescent layers (17A) and (17B), respectively, of the cell (15A) may be of different wavelengths.

[0055] Optionally, the cell (15A) further comprises an optical filter layer (16) comprising a suitable optical filter superposed over said first upper electrode (22A) of said first pair of electrodes (23A), and over said second upper electrode (22B) of said second pair of electrodes (23B). The said optical filter layer (16) adapted to enable the visible light emitted by said cell (15A) from each luminescent layer to be of a predetermined colour, preferably one of the primary colours red, green or blue. Thus, if either one or both of the said first and/or second luminescent layers (17A) and (17B) emit substantially white light, for example, then by providing a red, green or blue filter-layer (16), the emitted light is correspondingly filtered to red, green or blue, respectively. Of course, suitable filters may usually be employed to modify where possible the wavelength of the emitted light, even when the emitted light is not white light. Alternatively, a separate, and optionally different, filter layer may be superposed over each one of said first upper electrode (22A) and said second upper electrode (22B), thereby enabling the emitted light from each one of the said first and second luminescent layers (17A) and (17B) to be of a different colour.

[0056] The said device (10) may then be conveniently arranged such that the colour cells (15A) are divided into clusters of three cells (15A) each, a "red" cell, a "green" cell and a "blue" cell, wherein the light emitted by the both the first and second said luminescent layers (17A) and (17B) of the each cell (15A) is respectively red, green and blue. In this manner, a range of colours may be perceived to be emitted from the cluster of cells (15A), according to the combination of cells (15A) in the cluster that are activated, i.e., that are emitting light, at any given time.

[0057] As hereinbefore described, the cells, (15) and (15A) may be activated to emit light by the application of a predetermined voltage across the corresponding upper and lower electrodes. This feature of the cells enables the control of cells to provide predetermined images to be performed in a manner similar to that used for the control of pixels in a typical flat LCD computer screen. With respect to the cell (15) for example, the display device (10) may be considered to comprise a plurality of these cells (15), for convenience arranged in an array or grid comprising consecutive rows and columns of cells (15), as illustrated for example in Figure 3. While in this Figure, a substantial gap is shown between cells (15), in practice the cells (15) are very close together. The device (10) may comprise a series of first input lines (L1) and a series of second input lines (L2) superposed and orthogonal with respect to the said series of first input lines (L1), such as to provide an electrical node (N) at each intersection between a first input line (L1) and a second input line (L2). The rows and columns of cells (15) are arranged such that each cell (15) is in close proximity to an individual node (N), with either the upper electrode (22) or the lower electrode (24) of the cell (15) electrically connected thereto. The lower electrode (24), or upper electrode (22), respectively, may be earthed, for example, or otherwise suitable routed to a terminal of the power source. The series of first input lines (L1), corresponding to the rows of cells (15), are sequentially connected to a suitable terminal of an electrical power source to provide a voltage of less than (Vp), and preferably about (Vp)/2 to each row of cells (15) in turn. Concurrently, said series of second input lines (L2), corresponding to said columns of cells (15), may also be connected in a selective manner to a suitable terminal of the same or a different electrical power source to provide a voltage of less than (Vp), and preferably about (Vp)/2 to each selected column of cells such that there will be a voltage of (Vp) or greater at nodes (N) corresponding to a row and a column of cells which is directly connected to the power source in this way, enabling the corresponding luminescent layers (17) of the cells (15) at these nodes to be activated and thus emit light, and such that all other nodes will have a voltage of less than (Vp), and will therefore not be activated. In this manner, by synchronising which of the second input lines (L2) to connect to the power source during the sequencing of connections of the power source to the series of first input lines (L1), the particular nodes (N) to be at voltage (Vp) at any one time can be chosen, and thus by also choosing the colour of emitted light that may be obtained from each cell (15) as hereinbefore described, the particular cells (15) on the device (10) that are activated and therefore emit light of a particular colour at any one time may be controlled. Alternatively, selected cells (15) may be similarly activated by supplying thereto suitable electrical currents via the said first and second input lines (L1) and (L2), respectively, such as to provide sufficient electrical current at the selected cells to activate the same to emit light, while providing less than sufficient electrical current to all other cells, which are thus not activated. Thus, the device (10) may be adapted to provide any desired image or sequence of images. Such synchronisation and sequencing may be accomplished typically by a suitable microprocessor (91), for example.

[0058] Alternatively, the said device (10) comprising cells (15) and/or cells (15A) of the preferred embodiment, may be controlled by means of circuit boards (70) as hereinafter described with reference to the second disclosed colour cells, *mutatis mutandis*.

[0059] Each of the first and second luminescent layers (17A) and (17B), respectively of the cell (15A) according to the preferred embodiment of the present invention may be similarly controlled as described above for the cells (15) *mutatis mutandis*. Optionally, the first and second pairs of electrodes, (23A), (23B) respectively, of each cell (15A) may be electrically connected to common first input lines (L1), though to two distinct sets of second voltage lines (L2). Of course, the device (10) may comprise any number of any one of the embodiments described herein, in any combination and/or arrangement, as desired.

[0060] The said power source may comprise a suitable DC battery, or additionally or alternatively a suitable photo-electric cell such as a solar cell, for example. Advantageously, the power source is comprised on said substrate, and may be suitably printed on it in a manner known in the art, particularly in applications when the device (10) is manufactured using similar techniques used for manufacturing microprocessors as well as printed circuits. Alternatively, the said power source may comprise an AC power source, preferably operatively connected to a suitable rectifier.

[0061] Also disclosed herein is a method for manufacturing the device (10) comprising said colour cells (15) or cells (15A) of the said preferred embodiment, comprising the steps of:-

(a) preparing a suitable substrate;

(b) forming at least one suitable substantially colourless lower electrode using a paste mask method in which desired parts of a foil of suitable material superposed over said spacers is rendered, or remains conductive, while other parts remain, or are rendered, respectively, non-conductive;

(c) printing at least one suitable luminescent layer corresponding to and superposed over said at least one lower electrode;

5 (d) printing a suitable dielectric layer over said at least one luminescent layer, optionally including exposed parts of said substrate;

(e) forming at least one suitable substantially colourless upper electrode corresponding to and superposed over said at least one upper electrode a paste mask method.

10 [0062] Optionally, steps (c) and (d) may be replaced with the following steps:-

(d) printing a suitable dielectric layer over said at least one lower electrode, optionally including exposed parts of said substrate;

15 (c) printing at least one suitable luminescent layer over said dielectric layer, corresponding to and superposed over said at least one lower electrode.

[0063] Optionally, step (e) may be followed by step (f) below:-

20 (f) printing a suitable optical filter layer over said at least one upper electrode and optionally over exposed parts of said substrate and/or over exposed parts of said dielectric layer and/or exposed parts of said at least one luminescent layer.

25 [0064] Also disclosed is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour, each said colour cell comprising:-

30 an electrically heatable base comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said base to a suitable electrical power source, said base capable of being electrically heated at least from a first temperature to at least a second temperature in response to the supply of a predetermined voltage and/or current thereto;

35 thermally responsive colour change means in thermal contact with said base, said colour change means enabling said cell to exhibit a colour change from said first colour to said second colour in response to said temperature change of the said base from said first temperature to said at least second temperature.

40 [0065] The said suitable electrical connections comprises an electrically heatable base comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said base to a suitable electrical power source, said base capable of being electrically heated at least from a first temperature to at least a second temperature in response to the supply of a predetermined voltage and/or current thereto; and furthermore, said colour change and/or luminescent means comprises thermally responsive colour change means in thermal contact with said base, said colour change means enabling said cell to exhibit a colour change from said first colour to said second colour in response to said temperature change of the said base from said first temperature to said at least second temperature.

45 [0066] Optionally, said colour change means are reversible such that the said colour cell is capable of exhibiting a colour change from said second colour to said first colour in response to a reduction of the temperature of the said base to a temperature at least substantially below said second temperature.

50 [0067] Also disclosed herein is a picture display device wherein said colour change means comprises a suitable layer of thermochromic material capable of exhibiting a colour change from said first colour to said second colour in response to a change of temperature of said base from said at least first temperature to said at least said second temperature.

55 [0068] The said colour change means may comprise a suitable layer of thermochromic material capable of exhibiting a colour change from said first colour to colourless in response to a change of temperature of said base from said at least first temperature to said at least said second temperature, said thermochromic material superposed directly or indirectly over a colour layer of said second colour, such that the said colour cell may exhibit said second colour when said thermochromic layer is colourless.

[0069] Alternatively, said colour change means comprises a suitable layer of thermochromic material capable of exhibiting a colour change from colourless to said second colour in response to a change of temperature of said base

from said at least first temperature to said at least said second temperature, said thermochromic material superposed directly or indirectly over a colour layer of said first colour, such that the said colour cell may exhibit said first colour when said thermochromic layer is colourless.

[0070] The said colour layer may be disposed at least intermediate said thermochromic layer and said base. Alternatively the said colour layer may be disposed at least intermediate said base and said substrate, said base being preferably substantially colourless and transparent. Alternatively, the said colour layer may be disposed on a lower face of said substrate and substantially aligned at least with said thermochromic layer, said base and said substrate being substantially colourless.

[0071] Alternatively, the said colour change means may comprise a suitable layer of thermochromic material capable of exhibiting a colour change from said first colour to said second colour in response to a change of temperature of said base from said at least first temperature to said at least said second temperature, wherein at least the colour of said second colour is variable with respect to the magnitude of said second temperature.

[0072] Also disclosed are second disclosed colour cells in Figures 4 and 5, third disclosed colour cells in Figures 6 and 7, and fourth disclosed colour cells in Figures 8 and 9, respectively, the display device, generally designated (10) comprises a suitable substrate (20) as described herein with reference to the preferred embodiment, *mutatis mutandis*, carrying a plurality of colour cells, designated (115), (215) and (315) for the second, third and fourth embodiments respectively.

[0073] Each of the colour cells (115, 215, 315) of the device (10) comprises an electrically conducting base (110), having at least one suitable electrical input connection means (120) and at least one suitable electrical output means (130), for enabling the base (110) to be electrically connected, directly or alternatively indirectly, to a suitable electrical power source (99). In these embodiments, the base (110) is capable of being heated in a predetermined manner in response to the application of a voltage across same and/or the passage of a suitable electrical current therethrough. The base (110) is thus typically comprised of a conducting or semiconducting material having a suitable electrical resistance, for example. The said base (110) may also be made from some materials which are generally considered non-conductive materials, but which may nonetheless enable an electrical current to pass therethrough under certain conditions, in particular when the non-conducting material is in the form of a very thin layer constituting the base (110).

[0074] The said cells (115, 215, 315) further comprise colour change means in thermal contact with the base (110). The colour change means enable a first colour (41) to be exhibited by the corresponding colour cell (115, 215, 315) when the cell (115, 215, 315) is disconnected from an electrical power source, and a second colour (42) to be exhibited by the cell (115, 215, 315) in response to a substantial change in temperature of the base (110). While the change in temperature of the base (110) is achieved by the passage of a suitable electric current therethrough and/or the application of a voltage thereto, there may be additional temperature effects arising from the environment in which the device is operated.

[0075] In figure 4, the said colour change means comprises a layer (140) of thermochromic material, extending at least over the said base (110), and may optionally contiguous over part or all of the device (10). Thermochromic materials are well known in the art and include, for example, Tungsten oxide. The thermochromic material in said thermochromic layer (140) may undergo a colour change, in response to a change in its temperature, in a number of different ways. Thus, for example, the thermochromic layer (140) of the cell (115) may exhibit a first colour (41) over its upper exposed surface (145) when no current is passed therethrough (Figures 5(a) and 5(c)), but changes its colour to said second colour (42) when current is switch on, Figures 5(b) and 5(d), and the base (110) and overlying thermochromic layer (140) are heated as a result thereof. Alternatively, the thermochromic layer (140) may exhibit a colour change from said first colour to colourless, i.e. it becomes substantially transparent, when the power source is operatively connected thereto and the said base (110) is heated to at least said second temperature, the base preferably being of said second colour (42), or alternatively comprising a colour layer comprising said second colour (42). Alternatively, the thermochromic layer (140) may exhibit a colour change from colourless, i.e., transparent, to said second colour (42), when the power source is operatively connected thereto, the base preferably being of said first colour (41), or alternatively comprising a colour layer comprising said first colour (41).

[0076] Alternatively, the thermochromic layer may exhibit a change in its colour as a function of its actual temperature. The actual colours of said first colour (41) and said second colour (42) will thus depend on the actual temperature of the thermochromic layer (140) before activation of the cell (115), as well as on the actual temperature change that occurs as a result of the passage of current through the base (110) and/or the application of a voltage thereto, including any changes in ambient temperature that occur. Further, by changing the magnitude of the current flowing through the base (110) or alternatively the magnitude of the voltage applied thereto, the temperature thereof may be controlled, and thereby, the colour of the said second colour (42) may be changed in correlation to the magnitude of the current and/or voltage. Further, the ambient environmental temperature may also affect the colour of at least the said second colour. For example, in a relatively cold environment there will be a greater change in the colour of the second colour for a given magnitude of electrical current as compared with a relatively hotter environment.

[0077] Also disclosed is a method for manufacturing the said device comprising said second disclosed colour cell

(115) comprising the steps of:-

- (a) preparing a suitable substrate;
- 5 (b) printing a plurality of bases on said substrate corresponding to each cell of said device using a suitable printing material, each said base being suitably spaced with respect to an adjacent base;
- (c) for each said base, printing corresponding said electrical input connection means and said electrical output connection means using a suitable conducting ink;
- 10 (d) applying a layer of thermochromic material over said substrate, bases and input and output connection means.

[0078] Thus, the structure of the second disclosed colour cell (115) is particularly suitable for enabling such cells to be manufactured layer by layer in a manner similar to that used in manufacturing printed circuits and particularly integrated circuits and microchips, as well as by suitable printing methods.

[0079] Alternatively, said colour change means comprises:-

20 a suitable bimaterial strip comprising a first layer of a first material having a first coefficient of thermal expansion superposed on, and in substantially shearless contact with, a second layer of a second material having a second coefficient of thermal expansion, said second coefficient of thermal expansion being greater than said first coefficient of thermal expansion, said bimaterial strip being in thermal contact at an edge thereof with said base such that at least a part of said first layer and at least a part of said second layer are in thermal contact with said base, said strip projecting from said base;

25 a colour layer of said second colour comprised on an exposed face of said second layer of said strip; and

a first area at least on said base having said first colour, said first area in juxtaposition with an exposed face of said first layer of said strip;

30 whereby said bimaterial strip bends from a first configuration to a second configuration in response to said temperature change of said base from said at least first temperature to said at least second temperature, wherein in said first configuration said strip is substantially perpendicular to said base enabling said first colour on said first area to be exhibited, and wherein in said second configuration said strip is substantially bent towards said first area substantially covering said first colour on said first area and enabling said second colour of the said colour layer comprised on the said second layer to be exhibited.

35 [0080] Alternatively, said colour change means comprises:-

40 a suitable bimaterial strip comprising a first layer of a first material having a first coefficient of thermal expansion superposed on, and in substantially shearless contact with, a second layer of a second material having a second coefficient of thermal expansion, said second coefficient of thermal expansion being greater than said first coefficient of thermal expansion, said bimaterial strip being in thermal contact at an edge thereof with said base such that at least a part of said first material and at least a part of said second material are in thermal contact with said base, said strip projecting from said base;

45 a colour layer of said first colour comprised on an exposed face of said first layer of said strip;

a first area at least on said base having said first colour, said first area in juxtaposition with an exposed face of said first layer of said strip;

50 a colour layer of said second colour comprised on an exposed face of said second layer of said strip;

a second area at least on said base having said second colour, said second area in juxtaposition with an exposed face of said second layer of said strip; and

55 whereby said bimaterial strip changes from a first configuration to a second configuration in response to said temperature change of said base from said at least first temperature to said at least second temperature, wherein in said first configuration said strip is substantially bent towards said second area substantially covering said second colour on said second area and enabling said first colour of the said colour layer comprised on the said first layer and

said first colour on said first area to be exhibited, and wherein in said second configuration said strip is substantially bent towards said first area substantially covering said first colour on said first area and enabling said second colour of the said colour layer comprised on the said second layer and said second colour on said second area to be exhibited.

[0081] Thus, the third and fourth disclosed colour cells are shown in Figure set 6 and 7 and Figure set 8 and 9, the said colour cell, (215) and (315) respectively, comprises at least a first area (210) having said first colour (41), which may be painted or printed thereon as a colour layer, for example. The said colour change means comprises a suitable bimaterial strip, (200) and (300) respectively, comprising a first layer (211) of a first material (231) having a first coefficient of thermal expansion, superposed on a second layer (212) of a second material (232) having a second coefficient of thermal expansion. The first layer (211) and second layer (212) are securely attached to each other, preferably bonded together, and the said second coefficient of thermal expansion is chosen to be greater than said first coefficient of thermal expansion, in order to control the primary direction of bending or distortion of the strip (200, 300). Thus when heated, the said bimaterial strip (200, 300) bends due to the difference in the thermal expansion coefficients, with the outer surface (242) of second layer (212) becoming generally convex, while the outer surface (241) of said first layer (211) becomes correspondingly concave. In particular, when the width of the strip (200, 300) is significantly smaller than the length thereof, the strip bends primarily along the lengthwise dimension. The said bimaterial strip, (200, 300) is in thermal contact with said base (110) and projecting therefrom, such that said first layer (211) and said second layer (212) are in thermal contact with the base (110). Preferably the strip (200, 300) is mounted to the base (110) along the narrow width of the strip (200, 300). The said first area (210) is typically located next to the said first layer (211), as illustrated in the Figures 6 to 9. The said strip (200, 300) comprises a layer or coating of said second colour (42) on the surface (242) of said second layer (212), such as to allow said second colour (42) on the said surface (242) to be exhibited when the strip (200) bends over to the said second position.

[0082] Referring to Figures 6 and 7 the said base (110) is heated in response to the passage of current therethrough and/or the application of a voltage thereto, and the base (110) correspondingly heats the said bimaterial strip (200) from, say, a first temperature to a second temperature. The strip (200) correspondingly defects or bends from a first, substantially upright position, wherein said first colour (41) on said first area (210) is exposed and exhibited, to a second position, wherein the strip (200) bends over and substantially covers said first colour (41) on said first area (210), exposing and exhibiting said second colour (42) on said surface (242).

[0083] Referring to Figures 8 and 9, which show the fourth disclosed colour cell (315) further comprising at least a second area (220) having said second colour (42), which may be painted or printed thereon as a colour layer, for example. In the cold state (i.e., in the absence of a heating effect from the base (110)), the strip (300) is biased to be bent over away from said first area (210), and actually covering said second area (220), which is typically disposed next to the said second layer (212), as illustrated in the Figures 8 and 9. The said strip (300) comprises a layer or coating of said first colour (41) on the surface (241) of said first layer (211), such as to allow said first colour (41) on the said surface (241) to be exhibited together with that on said first area (210), when the strip (300) is in said first position.

[0084] The said base (110) is heated in response to the passage of current therethrough and/or the application of a voltage thereto, and the base (110) correspondingly heats the said bimaterial strip (300) from, say, a first temperature to a second temperature. The strip (300) correspondingly deflects or bends from a first, biased position, substantially covering said second area (220), and wherein said first colour (41) on said first area (210) and on said surface (241) is exposed and exhibited, to a second position, wherein the strip (300) bends over to substantially cover said first colour (41) on said first area (210) and wherein said second colour (42) on said second area (220) and said surface (242) is exposed and exhibited.

[0085] Also disclosed is a method for manufacturing the said device (10) comprising said third disclosed colour cells (215) comprising the steps of:-

(a) preparing a suitable substrate;

(b) preparing a suitable zebra plate comprising a plurality of bimaterial elements and applying a layer of said second colour over the exposed face of said second layer of said bimaterial elements;

(c) printing a plurality of bases on said substrate corresponding to each cell of said device using a suitable printing material, each said base being suitably spaced with respect to an adjacent base;

(d) for each said base, printing corresponding said electrical input connection means and said electrical output connection means using a suitable conducting ink;

(e) applying a colour layer of said first colour over said first area of each cell;

(f) bonding said zebra plate onto said substrate such that each bimaterial element of said strip is bonded to a corresponding set of bases;

(g) cutting each bimaterial element adhered to each set of bases into individual bimaterial strips for each cell.

[0086] Also disclosed is a method for manufacturing the said device (10) comprising said fourth disclosed colour cells (315) comprising the steps of:-

(a) preparing a suitable substrate;

(b) preparing a suitable zebra plate comprising a plurality of bimaterial elements and applying a layer of said first colour over the exposed face of said first layer of said bimaterial strips, and a layer of said second colour over the exposed face of said second layer of said bimaterial strips, said bimaterial strips being in said first configuration at least at said first temperature;

(c) printing a plurality of bases on said substrate corresponding to each cell of said device using a suitable printing material, each said base being suitably spaced with respect to an adjacent base;

(d) for each said base, printing corresponding said electrical input connection means and said electrical output connection means using a suitable conducting ink;

(e) applying a colour layer of said second colour over said second area of each cell;

(f) applying a colour layer of said first colour over said first area of each cell;

(g) preheating said zebra plate to a predetermined temperature such that said bimaterial elements are substantially perpendicular to said zebra plate;

(h) bonding said zebra plate onto said substrate substantially at said predetermined temperature such that each bimaterial element of said strip is bonded to a corresponding set of bases;

(i) cutting each bimaterial element adhered to each set of bases into individual bimaterial strips for each cell.

[0087] Alternatively, the third disclosed colour cell (215) shown in Figures 6 and 7 may be configured differently wherein the, said colour change means comprises:-

a suitable bimaterial strip comprising a first layer of a first material having a first coefficient of thermal expansion superposed on, and in substantially shearless contact with, a second layer of a second material having a second coefficient of thermal expansion, said second coefficient of thermal expansion being greater than said first coefficient of thermal expansion, said bimaterial strip being in thermal contact at an edge thereof with said base such that at least a part of said first material and at least a part of said second material are in thermal contact with said base, said strip projecting from said base;

a colour layer of said first colour comprised on an exposed face of said first layer of said strip; and

a second area at least on said base having said second colour, said second area in juxtaposition with an exposed face of said second layer of said strip;

whereby said bimaterial strip bends from a first configuration to a second configuration in response to said temperature change of said base from said at least first temperature to said at least second temperature, wherein in said first configuration said strip is substantially bent towards said second area substantially covering said second colour on said second area and enabling said first colour of the said colour layer comprised on the said first layer to be exhibited, and wherein in said second configuration said strip is substantially perpendicular to said base enabling said second colour on said second area to be exhibited.

[0088] Also disclosed herein is a method for manufacturing the device (10) comprising said alternative configuration of said colour cells (215) comprising the steps of:-

(a) preparing a suitable substrate;

(b) preparing a suitable zebra plate comprising a plurality of bimaterial elements and applying a layer of said first colour over the exposed face of said first layer of said bimaterial strips, said bimaterial strips being in said first configuration at least at said first temperature;

(c) printing a plurality of bases on said substrate corresponding to each cell of said device using a suitable printing material, each said base being suitably spaced with respect to an adjacent base;

(d) for each said base, printing corresponding said electrical input connection means and said electrical output connection means using a suitable conducting ink;

(e) applying a colour layer of said second colour over said second area of each cell;

(f) preheating said zebra plate to a predetermined temperature such that said bimaterial elements are substantially perpendicular to said zebra plate;

(g) bonding said zebra plate onto said substrate substantially at said predetermined temperature such that each bimaterial element of said strip is bonded to a corresponding set of bases;

(h) cutting each bimaterial element adhered to each set of bases into individual bimaterial strips for each cell.

[0089] Thus, the third and fourth disclosed colour cell (215), (315) respectively, may be manufactured via a process comprising first forming the base (110) and electrical input connection means (120) and electrical output means (130), as "printed" layers on substrate (20), in a manner similar to that used in manufacturing printed circuits and particularly integrated circuits and microchips. Preferably, the cells are arranged in a rectangular grid of rows and columns. In a separate operation, a series of bimetallic strips are manufactured in the form of a zebra plate, as is known in the art. The strips are aligned over the bases of cells of, say, corresponding columns of cells, and each strip is bonded or otherwise adhered onto the corresponding column, so that each column of cells comprises a continuous bimetallic strip joining adjacent cells together, the strip extending away from the bases of the cells substantially perpendicularly to same. A laser is then used to cut the strip into portions corresponding to each individual cell, such that each cell comprises a single bimetallic strip element joined to its base (110). In the third disclosed colour cell, the bonding of the bimetallic strip onto the bases (110) occurs with the bimetallic strip at approximately the normal working temperature of the device (10). In the fourth embodiment, the bimetallic strips of the zebra plate are originally manufactured at a much higher temperature than the normal working temperature of the device (10) approximately intermediate between the working temperature and the highest temperature to which the base (110) is normally heated in. the normal operation of the colour cell. At such an intermediate temperature, the bimetallic strips are substantially rectilinear and perpendicular to the base (110). Bonding of the bimetallic strips to the said bases (110) is effected as for the third embodiment, except at the elevated intermediate temperature, and then the strip is cut into the individual cell units as before. When the individual strips eventually cool down to the normal working temperature of the cell, in general the ambient temperature, they will naturally bend away from said first area (210) to expose the side having said first colour.

[0090] Typically, the said bimaterial strip (200, 300) constitutes a bimetallic strip comprised of two suitable metals having substantially different coefficients of thermal expansion in shearless contact with one another. Said first material may be iron, and said second material may be brass, for example.

[0091] In the second, third and fourth disclosed colour cells, at least the said base (110) of adjacent colour cells (115, 215, 315) are electrically insulated one from another. Such insulation may be achieved by means of an insulating material placed at least between the said bases of adjacent colour cells, or alternatively by means of a non-electrically-conductive space existing between at least the said bases of adjacent colour cells.

[0092] Also disclosed herein is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour, each said colour cell comprising:-

a first, upper, substantially transparent layer comprising an inverted substantially transparent prismatic element protruding from a lower surface thereof; said transparent layer being superposed over:

a second, lower, substantially transparent layer comprising an upper concavity complementary to and substantially aligned with said prismatic element, said second transparent layer being superposed over said substrate;

said first transparent layer capable of being displaced a first distance between a first position and a second

position, wherein in said first position said concavity is substantial direct optical contact with said prismatic element, and wherein in said second position said concavity is spaced from said prismatic element by a predetermined spacing;

5 a colour layer comprising said first colour disposed below said second transparent layer and in optical communication therewith;

at least one actuator element in abutting contact with first transparent layer comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of
10 connecting said at least one actuator element to a suitable electrical power source, said at least one actuator element characterised in being capable of increasing at least one dimension thereof in the direction of displacement of said first transparent layer by said first distance in response to the supply of a predetermined voltage and/or current thereto, thereby displacing said first transparent layer to said first position;

15 whereby said actuator element increases said at least one dimension thereof by said first distance in response to the supply of a predetermined voltage and/or current to said actuator element, thereby propelling said first transparent layer from said first position to said second position and establishing said spacing between said prismatic element and said concavity, said prismatic element having a configuration such as to internally reflect light entering said cell via said upper transparent layer thereby enabling said colour cell to exhibit a second colour as determined by the reflection
20 of external light by said prismatic element, and whereby said actuator element returns to its datum dimension when said electrical power source is subsequently disconnected or alternatively when the polarity of the said voltage and/or current supply is reversed, returning said first transparent layer to the said first position and bringing said concavity is substantial direct optical contact with said prismatic element thereby enabling said first colour on said colour layer to be exhibited by said colour cell.

25 **[0093]** Thus, in the fifth disclosed colour cells, the said suitable electrical connections comprises at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said at least one actuator element to a suitable electrical power source; and furthermore, the said colour change and/or luminescent means comprises :-

30 a first, upper, substantially transparent layer comprising an inverted substantially transparent prismatic element protruding from a lower surface thereof; said transparent layer being superposed over:

a second, lower, substantially transparent layer comprising an upper concavity complementary to and substantially aligned with said prismatic element, said second transparent layer being superposed over said substrate;
35

said first transparent layer capable of being displaced a first distance between a first position and a second position, wherein in said first position said concavity is substantial direct optical contact with said prismatic element, and wherein in said second position said concavity is spaced from said prismatic element by a predetermined spacing;
40

a colour layer comprising said first colour disposed below said second transparent layer and in optical communication therewith;

45 at least one actuator element in abutting contact with first transparent layer comprising said at least one suitable electrical input connection means and said at least one suitable electrical output connection means, said at least one actuator element characterised in being capable of increasing at least one dimension thereof in the direction of displacement of said first transparent layer by said first distance in response to the supply of a predetermined voltage and/or current thereto, thereby displacing said first transparent layer to said first position;
50

whereby said actuator element increases said at least one dimension thereof by said first distance in response to the supply of a predetermined voltage and/or current to said actuator element, thereby propelling said first transparent layer from said first position to said second position and establishing said spacing between said prismatic element and said concavity, said prismatic element having a configuration such as to internally reflect light entering said cell via said upper transparent layer thereby enabling said colour cell to exhibit a second colour as determined by the reflection
55 of external light by said prismatic element, and whereby said actuator element returns to its datum dimension when said electrical power source is subsequently disconnected or alternatively when the polarity of the said voltage and/or

current supply is reversed, returning said first transparent layer to the said first position and bringing said concavity in substantial direct optical contact with said prismatic element thereby enabling said first colour on said colour layer to be exhibited by said colour cell.

[0094] Referring to Figure set 10 and 11, the picture display device (10) comprises a suitable substrate (20) as described with reference to the preferred embodiment, *mutatis mutandis*, carrying a plurality of colour cells (615), wherein each colour cell (615) is capable of exhibiting a change in its external colour, said change being correlated to the application of an electrical voltage across said colour cell (615). Each said colour cell (615) comprises a colour layer (650) comprising a first colour (41), and further comprises a first upper substantially transparent layer (660) having an upper and a lower surface, (661) and (662) respectively, said first transparent layer (660) being superposed over said substrate (20) and distanced therefrom.

[0095] The said first transparent layer (660) comprises a substantially transparent prismatic element (665) wherein the base (666) of the prismatic element (665) is on the lower surface (662) of the said first transparent layer (660).

[0096] The prismatic element (665) may similarly take the form of a regular triangular prism, or alternatively a pyramidal form having a rectangular or polygonal base, or alternatively a conical form. Preferably, said prismatic element (665) is integral with said lower surface (662), though alternatively, said prismatic element (665) may be mounted or bonded onto said lower surface (662) by any suitable means. Advantageously, said first transparent layer (660) and said prismatic element (665) comprise substantially identical refractive indices.

[0097] The said colour cell (615) further comprises a second transparent layer (680) superposed onto said substrate (20) at least over said colour layer (650), said second transparent layer (680) characterised in comprising an upper concavity (685) aligned with and complementary to said prismatic element (665). Said first transparent layer (660) is superposed over said second transparent layer (680) such as to ensure substantial contact between facing surfaces of the prismatic element (665) and the said concavity (685).

[0098] Alternatively, said substrate (20) may constitute the said second transparent layer (680), the substrate (20) thus comprising said upper concavity (685) aligned with and complementary to said prismatic element (665). In this case, said first transparent layer (660) is superposed over said substrate (20) such as to ensure substantial contact between facing surfaces of the prismatic element (665) and the said concavity (685).

[0099] Alternatively, said second transparent layer (680) is integral with said substrate (20).

[0100] The said colour layer (650) may be disposed at least intermediate said second transparent layer (680) and said substrate (20). Alternatively, said colour layer (650) is disposed on a lower face of said substrate (20) and substantially aligned at least with said prismatic element (665), said substrate (20) being substantially transparent.

[0101] The said cell (615) further comprises at least one actuator element (670), and preferably a plurality thereof. Said actuator element (670) is characterised in increasing at least one dimension thereof in response to an electrical voltage applied across the actuator element (670) and/or the passage of an electrical current therethrough, said actuator element (670) typically comprises an active gel or shape memory alloy, among other materials. Alternatively, said actuator element (670) may comprise a suitably-configured piezoelectric crystal. Alternatively, the actuator element (670) may comprise a ferromagnetic material, preferably a ferromagnetic liquid. The actuator element (670) is superposed over said substrate (20) and comprises at least one pair of conductors (620) and (630). The said actuator element (670) is also in contact with, and preferably bonded to, the lower surface (662) of said first transparent layer (660). At least one suitable electrical input connection means (120) and at least one suitable electrical output connection means (130) are operatively connected to said conductors (620) and (630), respectively, for enabling said conductors (620) and (630) to be electrically connected to a suitable electrical power source, and thus to provide an electrical voltage across at least part of said actuator element (670) and/or an electrical current therethrough. The said actuator element (670) increases at least one dimension thereof from a datum magnitude (D61) to an extended magnitude (D62) in response to an electrical voltage applied across the actuator element (670) and/or the passage of an electrical current therethrough, by means of said conductors (620) and (630).

[0102] The dimension is chosen as the depth of the actuator element (670) taken in the direction extending perpendicularly from the substrate (20) to the said transparent layer (660).

[0103] The colour cell (615) further comprises at least one guiding means for facilitating reciprocation of said first transparent layer (660) between said first position and said second position. Thus, at least one guiding means (690) substantially enables said actuator element (670) to expand between said datum magnitude (D61) to said extended magnitude (D62). Typically, the guiding means (690) may comprise a suitably profiled well (692) in said second transparent layer (680). Thus the guiding means (690) may comprise a number of narrow rectangular wells (692) aligned along each side of the cell (615) and extending to said substrate (20), and which permit direct contact of said actuator element (670) (optionally including said lower conductor (630)) with the said substrate (20). Alternatively, said guiding means (690) may comprise a number of rectangular wells (693) aligned along each side of the cell (615) and extending partially into said second transparent layer (680), wherein said actuator element (670) is thus only afforded indirect contact with the said substrate (20).

[0104] Thus, the said datum magnitude (D61) is such as to ensure substantial contact between facing surfaces of

said prismatic element (665) and said concavity (685). Under this condition, light entering said colour cell (615) via said upper transparent layer (660) may be reflected by said first colour (41) and thus enable said colour cell (615) to exhibit said first colour (41), Figures 11(a) and 11(c). When voltage is applied across the cell (615), and/or a current flows therethrough, in particular by means of said conductors (620) and (630), the said actuator element (670) extends to said extended magnitude (D62), pushing against the said first transparent layer (660) and thus separating the same from the said second transparent layer (680), concurrently separating the said concavity (685) from the said prismatic element (665), and providing an air gap or clearance (611) therebetween. Said prismatic element (665) is suitably configured so, that in the absence of contact with said concavity (685), any light entering said cell (615) via said first transparent layer (660) is internally reflected by the prismatic element (665) and back out of the cell (615). Advantageously, a passage (616) through the said prismatic element (665) and said first transparent layer (660) facilitates the passage of ambient air, for example, to and from said clearance (611) during operation of the said colour cell (615). When the voltage is switched off, or alternatively the polarities reversed, the depth of the actuator element (670) reduces back to (D61), thereby reestablishing contact between the said prismatic element (665) and the concavity (685). An optically continuous path is thus reestablished between the prismatic element (665) and second transparent layer (680) such as to enable light passing through the prismatic element (665) to continue through the said second transparent layer (680) at the said concavity (685). Advantageously, at least one passage is comprised on said first transparent layer (660), optionally including said prismatic element (665), for enabling fluid communication between said spacing or clearance (611) and the external environment at least when said first transparent layer (660) is in said first position. Thus, at least one passage (616) through the said prismatic element (665) and said transparent layer (660) facilitates the passage of ambient air, for example, to and from said clearance (611) during operation of the said colour cell (615). [0105] Preferably, the said prismatic element (665) and said second transparent layer (680) comprise substantially equal refractive indexes.

[0106] The conductors (620), (630) shown in Figure 10(b) of adjacent colour cells (615) are electrically insulated one from another. Such insulation may be achieved by means of an insulating material placed at least between the said conductors (620), (630) of adjacent colour cells (615), or alternatively by means of a non-electrically-conductive space existing between at least the said conductors (620), (630) of adjacent colour cells (615).

[0107] Also disclosed herein is a method for manufacturing the device (10) comprising said fifth disclosed cells (615) comprising the steps of:-

(a) preparing a suitable substrate;

(b) suitably aligning and bonding said second transparent layer onto said substrate, said second transparent layer comprising suitable indentations over the upper surface thereof corresponding to said concavities of said cells;

(c) forming at least one suitable well in said second transparent layer corresponding to each said colour cell;

(d) printing suitable electrical input means or electrical output means in said well using a suitable conducting ink;

(e) inserting said actuator element in said well at least over said electrical input connection means or said electrical output connection;

(f) printing suitable electrical output means or electrical input means, respectively, over said actuator element using a suitable conducting ink.

(g) aligning and suitably bonding said first transparent layer onto said actuator element and/or said electrical output means, or electrical input means respectively;

(h) cutting suitable slots in said first transparent layer to separate said transparent layer into sections each corresponding to said cells;

(i) applying a colour layer of said first colour in step (a) optionally above or below said substrate.

[0108] Optionally, said colour cells do not comprise said second transparent layer, wherein step (b) is omitted, and all operations in steps (c) to (i) relating to said second transparent layer are performed with reference to said substrate (20), mutatis mutandis, said substrate (20) being substantially transparent.

[0109] Thus the colour cell (615) may be manufactured in a layer by layer manner as follows. Said colour layer (650) is superposed and bonded on said substrate (20) or alternatively printed or coated thereon. Next, said second transparent layer (680) is superposed and bonded onto said substrate (20) including said colour layer (650). Guiding means

(690) in the form of substantially rectangular wells (692) or (693) are then formed on said second transparent layer (680) along at least two opposite sides of the cell (615) by etching or by drilling by means known in the art, for example by laser. An actuating element (670) comprising conductors (620) and (630), and corresponding electrical input and output connection means, (120) and (130) respectively, is inserted into said guiding means (690).

5 **[0110]** Finally, said first transparent layer (660) comprising integrally-formed prismatic elements (665) is aligned over the cell (615) and bonded onto the said actuator elements (670) and/or the upper conductors (620). Finally, the said first transparent layer (660) is cut along two orthogonal series of parallel lines (668) and (669) to the full depth of the said first transparent layer (660), thereby defining the free edges (667) of the said first transparent layer (660) of the cell (615).

10 **[0111]** Also disclosed herein is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour, each said colour cell comprising:-

15 an upper substantially transparent layer comprising an inverted substantially transparent prismatic element protruding from a lower surface thereof, said transparent layer being superposed over said substrate and distanced therefrom by suitable spacing means;

20 a substantially transparent movable element comprising an upper concavity complementary to and substantially aligned with said prismatic element, said movable element capable of being displaced a first distance between a first position and a second position, wherein in said first position said concavity is spaced from said prismatic element by a predetermined spacing, and wherein in said second position said concavity is substantial direct optical contact with said prismatic element;

25 a colour layer comprising said second colour disposed below said movable element and in optical communication therewith;

guiding means for enabling said movable element to reciprocate between said first position and said second position;

30 at least one actuator element in abutting contact with said movable element comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said actuator element to a suitable electrical power source, said actuator element characterised in being capable of increasing at least one dimension thereof in the direction of displacement of said movable element by said first distance in response to the supply of a predetermined voltage and/or current thereto, thereby displacing said movable element to said first position;

35 whereby said at least one actuator element increases said at least one dimension thereof by said first distance in response to the supply of a predetermined voltage and/or current to said actuator element, thereby propelling said movable element from said first position to said second position and bringing said concavity in substantial direct optical contact with said prismatic element thereby enabling said second colour on said colour layer to be exhibited by said colour cell, and whereby said actuator element returns to its datum dimension when said electrical power source is subsequently disconnected or alternatively when the polarity of the said voltage and/or current supply is reversed, returning said movable element to the said first position and establishing said spacing between said prismatic element and said concavity, said prismatic element having a configuration such that in the said first position the said prismatic element internally reflects light entering said cell via said upper transparent layer thereby enabling said colour cell to exhibit a first colour as determined by the reflection of external light by said prismatic element.

45 **[0112]** In the sixth disclosed colour cell shown in Figure 12 and 13, the said suitable electrical connections comprises at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said actuator element to a suitable electrical power source; and furthermore the said colour change and/or luminescent means comprises :-

50 an upper substantially transparent layer comprising an inverted substantially transparent prismatic element protruding from a lower surface thereof, said transparent layer being superposed over said substrate and distanced therefrom by suitable spacing means;

55 a substantially transparent movable element comprising an upper concavity complementary to and substantially aligned with said prismatic element, said movable element capable of being displaced a first distance between a first position and a second position, wherein in said first position said concavity is spaced from said prismatic

element by a predetermined spacing, and wherein in said second position said concavity is substantial direct optical contact with said prismatic element;

a colour layer comprising said second colour disposed below said movable element and in optical communication therewith;

guiding means for enabling said movable element to reciprocate between said first position and said second position;

at least one actuator element in abutting contact with said movable element comprising said at least one suitable electrical input connection means and at least one suitable electrical output connection means, said actuator element characterised in being capable of increasing at least one dimension thereof in the direction of displacement of said movable element by said first distance in response to the supply of a predetermined voltage and/or current thereto, thereby displacing said movable element to said first position;

whereby said at least one actuator element increases said at least one dimension thereof by said first distance in response to the supply of a predetermined voltage and/or current to said actuator element, thereby propelling said movable element from said first position to said second position and bringing said concavity in substantial direct optical contact with said prismatic element thereby enabling said second colour on said colour layer to be exhibited by said colour cell, and whereby said actuator element returns to its datum dimension when said electrical power source is subsequently disconnected or alternatively when the polarity of the said voltage and/or current supply is reversed, returning said movable element to the said first position and establishing said spacing between said prismatic element and said concavity, said prismatic element having a configuration such as to internally reflect light entering said cell via said upper transparent layer thereby enabling said colour cell to exhibit a first colour as determined by the reflection of external light by said prismatic element.

[0113] Referring to figures 12 and 13, the picture display device (10) comprises a suitable substrate (20) as hereinbefore described with reference to the preferred embodiment, *mutatis mutandis*, carrying a plurality of colour cells (515) wherein each colour cell (515) is capable of exhibiting a change in its external colour, said change being correlated to the application of an electrical voltage across said colour cell (515) and/or a current flows therethrough. Referring to Figures 12 and 13, each said colour cell (515) of the sixth embodiment of the present invention comprises an upper substantially transparent layer (560) having an upper and a lower surface, (561) and (562) respectively, said transparent layer (560) being superposed over said substrate (20) and distanced therefrom. The said transparent layer (560) comprises a substantially transparent prismatic element (565), wherein the base (566) of the prismatic element (565) is on the lower surface (562) of the said transparent layer (560). Typically, said prismatic element (565) may take the form of a regular triangular prism, or alternatively a pyramidal form having a rectangular or polygonal base, or alternatively a conical form. Preferably, said prismatic element (565) is integral with said lower surface (562), though alternatively, said prismatic element (565) may be mounted or bonded onto said lower surface (562) by any suitable means. Advantageously, said transparent layer and said prismatic element comprise substantially identical refractive indices.

[0114] The colour cell (515) further comprises an actuator element (570) which is characterised in increasing at least one dimension thereof in response to an electrical voltage applied across the actuator element (570) and/or a current flows therethrough. Said actuator element (570) typically comprises an active gel or shape memory alloy, or any other suitable material. Alternatively, said actuator element (570) may comprise a suitably-configured piezoelectric crystal. Alternatively, the actuator element (570) may comprise a ferromagnetic material, preferably a ferromagnetic liquid. The actuator element (570) is superposed over and in direct or indirect contact with said substrate (20) and comprises at least one pair of conductors (520) and (530). At least one suitable electrical input connection means (120) and at least one suitable electrical output connection means (130) are operatively connected to said conductors (520) and (530), respectively, for enabling said conductors (520) and (530) to be electrically connected to a suitable electrical power source, and thus to provide a voltage across at least part of said actuator element (570) and/or a current therethrough. The said actuator element (570) increases at least one dimension thereof from a datum magnitude (D51) to an extended magnitude (D52) in response to an electrical voltage applied by means of said conductors (520) and (530) across the actuator element (570). In this embodiment, said dimension is chosen as the depth of the actuator element (570) taken in the direction extending perpendicularly from the substrate (20) to the said transparent layer (560).

[0115] The colour cell (515) further comprises a substantially transparent movable element (580) superposed on and in direct or indirect contact with said actuator element (570). Said movable element (580) comprises an upper concavity (585) complementary to and substantially aligned with said prismatic element (565). Preferably, said movable element (580) is suitably bonded or attached directly or indirectly to said actuator element (570).

[0116] The said cell (515) further comprises a second colour (42) below said movable element (580). Said second colour may be in the form of a layer (542) of colour at least between said movable element (580) and said actuator

element (570), and/or one of said conductors (520) and (530), providing said conductor (520) or (530), respectively, is disposed between said actuator element (570) and said movable element (580). Alternatively, if said actuator element (570) and where appropriate said conductors (520) and (530) are made from substantially transparent materials, the said second colour (42) of the said cell (515) may be in the form of a colour layer between said substrate (20) and at least said actuator element (570), and/or one of said conductors (520) and (530), providing said conductor (520) or (530), respectively, is disposed at least partially between said substrate (20) and said actuator element (570). Alternatively, the said actuator element (570) itself may be of said second colour (42). Alternatively, at least said conductor (520) may be of said second colour (42). Alternatively, said colour layer is disposed on a lower face of said substrate (20) and substantially aligned at least with said movable element (580), at least said actuator element (570) and said substrate (20) being substantially transparent, and preferably said conductors (520) and (530) are also substantially transparent.

[0117] The actuator element (570) is held in situ in substantial alignment with the movable element (580) by any suitable means, for example by means of a first spacing layer (581) superposed over said substrate (20) and comprising a suitable well (587) for accommodating said actuator element (570). Alternatively, said well (587) may be comprised in the substrate (20) itself, wherein said first spacing layer (581) may be redundant. Alternatively, said first spacing layer (581) and said substrate (20) form an integrated unit, said well being comprised in said first spacing layer (581) and optionally extending at least into said substrate (20).

[0118] The colour cell (515) further comprises guiding means (590) for enabling said movable element (580) to reciprocate between an upper position and a lower position corresponding the change in dimension of said actuator element (570) from said datum magnitude (D51) to said extended magnitude (D52), respectively. Typically, the guiding means may take the form of a number of parallel rail columns disposed between the said substrate (20) and the said transparent layer (560) and substantially orthogonal to both (the said substrate (20) and the said transparent layer (560) being substantially parallel), and located around the periphery of the said movable element (580). Alternatively, the rail columns may instead be disposed between the upper surface of said first spacing layer (581) and the said transparent layer (560). The movable element (580) may thus laterally abut the rail columns as it slides up and down to reciprocate between said upper position and said lower position to make and break contact, respectively, with said prismatic element (565). Alternatively, a second spacing layer (582) may be superposed onto said first spacing layer (581), said guiding means (590) comprising a suitably profiled well (592) in said second spacing layer (582). Advantageously, the said second spacing layer comprises a width substantially equal to the height of said movable element (580).

[0119] The said colour cell (515) comprises suitable spacing means (595) for maintaining a suitable clearance (511) between the said prismatic element (565) and said movable element (580) when the cell (515) is not connected to any electrical power source, while ensuring that substantial contact between the prismatic element (565) and said concavity (585) is achieved when a predetermined electrical voltage is applied to said cell (515) and/or an electrical current flows therethrough. Thus, the said rail columns, hereinbefore described, may constitute the spacing means, the rail columns being sized appropriately. Alternatively, the said first spacing layer (581) together with the second spacing layer (582) may constitute said spacing means, the total width of the said first spacing layer (581) and said second spacing layer (582) being such as to provide the required clearance (511). Alternatively, and preferably, where the said second spacing layer (582) is of substantially the same height as that of the said movable element (580), and the said actuator element (570) is of substantially the same depth as that of the said first spacing layer (581), the said spacing means (595) may comprise in addition to said first spacing layer (581) and said second spacing layer (582), a third spacing layer (583). Preferably, said third spacing layer (583) is superposed over said second spacing layer (582) and comprises an aperture (584) sufficient to permit the said movable element (580) to pass therethrough and establish contact with the said prismatic element (565) as hereinbefore described. The depth, i.e., thickness, of the third spacing layer (583) will then be similar to the required clearance (511), which in turn is substantially identical to the arithmetical difference between the said datum magnitude (D51) and said extended magnitude (D52).

[0120] Thus, the said extended magnitude (D52) is such as to ensure substantial contact between facing surfaces of said prismatic element (565) and said concavity (585). Under this condition, light entering said colour cell (515) via said upper transparent layer (560) may be reflected by said second colour (42) and thus enable said colour cell (515) to exhibit said second colour (42), Figures 13(b) and 13(d). When the said power source (99) is disconnected from the cell (515), the said actuator element (570) returns to its original datum magnitude (D51), lowering the said movable element (580) and breaking contact between the same and the said prismatic element (565), thus providing said clearance (511) between said concavity (585) and said prismatic element (565). Said prismatic element (565) is suitably configured so, that in the absence of contact with said concavity (585), any light entering said cell via said upper transparent layer is internally reflected by the prismatic element and back out of the cell (515), Figures 13(a) and 13(c). Advantageously, at least one passage is comprised on said upper transparent layer, optionally including said prismatic element, for enabling fluid communication between said spacing and the external environment at least when said movable element is in said first position. Thus, at least one passage (516) through the said prismatic element

(565) and said transparent layer (560) facilitates the passage of ambient air, for example, to and from said clearance (511) during operation of the said colour cell (515).

[0121] Thus, when an electrical voltage is applied to said cell (515) and/or a current flows therethrough as herein-before described, the said actuator element (570) increases its height from (D51) to (D52) thereby pushing against the movable element (580) which is brought into contact at its concavity (585) with the prismatic element (565). An optically continuous path is thus established between the prismatic element (565) and movable element (580) such as to enable light passing through the prismatic element (565) to continue through the said movable element (580) at the said concavity (585). Light entering the cell (515) via said transparent layer (560) thus penetrates the cell and is reflected by the said second colour (42), thereby enabling the cell (515) to exhibit this colour. When the said power source (99) is disconnected or alternatively if its polarity is reversed, the height of the actuator element (570) reduces back to (D51), thereby disengaging contact between the prismatic element (565) and the movable element (580). Light now entering the cell (515) via the transparent layer (560) will penetrate the prismatic element (565) and be internally reflected by it, the cell (515) thus appearing to reflect ambient light, thus masking the said second colour (42).

[0122] Preferably, the said prismatic element (565) and said movable element (580) comprise substantially equal refractive indexes.

[0123] In the colour cell shown in Figures 12 and 13, at least the said conductors (520), (530) of adjacent colour cells (515) are electrically insulated one from another. Such insulation may be achieved by means of an insulating material placed at least between the said conductors (520), (530) of adjacent colour cells (515), or alternatively by means of a non-electrically-conductive space existing between at least the said conductors (520), (530) of adjacent colour cells (515).

[0124] Also disclosed herein is a method for manufacturing the device (10) comprising said sixth disclosed colour cells (515) comprising the steps of:-

(a) preparing a suitable substrate;

(b) suitably bonding a first spacing layer onto said substrate;

(c) forming a well in said first spacing layer corresponding to each said colour cell;

(d) printing suitable electrical input means or electrical output means in said well using a suitable conducting ink;

(e) inserting said actuator element in said well at least over said electrical input connection means or said electrical output connection;

(f) printing suitable electrical output means or electrical input means, respectively, over said actuator element using a suitable conducting ink.

(g) suitably aligning and bonding a second spacing layer onto said first spacing layer around the periphery of each said well, said second spacing layer comprising suitable indentations over the upper surface thereof corresponding to said concavities of said cells;

(h) cutting suitable slots in said second spacing layer to separate said movable element from said second spacing layer;

(i) suitably bonding a third spacing layer onto said second spacing element and forming an aperture on said third element at least equal to the cross-sectional profile of said movable element;

(j) suitably bonding said upper transparent layer onto said third spacing layer;

(k) applying a colour layer of said second colour either in step (a) optionally above or below said substrate, or in step (g) on the lower surface of said second spacing element prior to bonding same onto said first spacing layer.

[0125] Optionally, said colour cells do not comprise said first spacing layer, wherein step (b) is omitted, and all operations in steps (c) to (k) relating to said first spacing layer are performed with reference to said substrate (20), mutatis mutandis.

[0126] Thus, the sixth disclosed colour cell (515) may be manufactured in a layer by layer manner as follows. Said first spacing layer (581) is superposed and bonded on said substrate (20), and said well (587) is etched or drilled into said first spacing layer (581) by means known in the art, for example by laser. An actuator element (570) comprising

conductors (520) and (530), and corresponding electrical input and output connection means, (120) and (130) respectively, is inserted into said well (587). Next, a second layer of an optically transparent material is superposed onto said first layer. This second layer comprises indentations across its upper surface corresponding to the concavity (585) of each cell (515), and the second layer is bonded onto the said first spacing layer (581) at predetermined locations or along its entire surface. A laser then cuts through the second layer along number of parallel and orthogonal lines in order to divide the said second layer into a movable element (580) and second spacing layer (582) for each cell (515). A third spacing layer (583) is then superposed and bonded onto said second spacing layer (582), while cutting into said third spacing layer (583) said aperture (584). Finally, said upper transparent layer (560) comprising integrally-formed prismatic elements (565) is aligned over the cell (515) and bonded onto the said third spacing layer (583).

[0127] Also disclosed herein is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour, each said colour cell comprising:-

a colour layer superposed on said substrate;

a layer of liquid crystal material comprising at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said liquid crystal layer to a suitable electrical power source, said liquid crystal layer capable of exhibiting a colour change in response to the supply of a predetermined voltage and/or current thereto;

said layer of liquid crystal material being substantially superposed over said colour layer and substantially spaced therefrom by at least a suitable clearance.

[0128] Thus a seventh disclosed colour cell is shown in Figures 14 and 15, the said suitable electrical connections comprises at least one suitable electrical input connection means and at least one suitable electrical output connection means capable of connecting said liquid crystal layer to a suitable electrical power source,; and furthermore, said colour change and/or luminescent means comprises :-

a colour layer superposed on said substrate;

a layer of liquid crystal material comprising said at least one suitable electrical input connection means and at least one suitable electrical output connection means, said liquid crystal layer capable of exhibiting a colour change in response to the supply of a predetermined voltage and/or current thereto;

said layer of liquid crystal material being substantially superposed over said colour layer and substantially spaced therefrom by at least a suitable clearance.

[0129] Optionally, the said liquid crystal layer is capable of exhibiting a colour change from said first colour to colourless in response to the supply of a predetermined voltage and/or current to said liquid crystal layer, and the said colour layer is of said second colour, such that the said colour cell may exhibit said second colour when said liquid crystal layer is colourless, wherein said first colour is the colour exhibited by the said liquid crystal layer when opaque.

[0130] Alternatively, the said liquid crystal layer is capable of exhibiting a colour change from colourless to said second colour in response to the supply of a predetermined voltage and/or current to said liquid crystal layer, and the said colour layer is of said first colour, such that the said colour cell may exhibit said first colour when said liquid crystal layer is colourless, wherein said second colour is the colour exhibited by the said liquid crystal layer when opaque.

[0131] Thus, referring to Figures 14 and 15, the picture display device (10) comprises a suitable substrate (20) as hereinbefore described with reference to the preferred embodiment, *mutatis mutandis*, carrying a plurality of colour cells (415) wherein each colour cell is capable of exhibiting a change in its external colour, said change being correlated to the application of an electrical voltage across said colour cell (415) and/or the passage of an electrical current therethrough. Each colour cell (415) comprises a colour layer (441) on said substrate (20). The colour cell (415) further comprises a layer (440) of a liquid crystal material, and at least part of said layer (440) is sandwiched between a pair of conductors (420) and (430) which are capable of creating an electric field between them. At least one suitable electrical input connection means (120) and at least one suitable electrical output connection means (130) are operatively connected to said conductors (420) and (430), respectively, for enabling said conductors (420) and (430) to be electrically connected to a suitable electrical power source, and thus to provide a voltage across at least part of said layer (440) and/or an electrical current therethrough. The said layer (440) may be colourless, i.e., transparent, when the cell (415) is not connected to any electrical power source, becoming opaque (and preferably said second colour) when said liquid crystal layer (440) is subjected to an electric field in response to the passage of an electrical current

to said conductors (420) and (430) and/or when an electrical current flows through said layer (440), wherein said colour layer (441) comprises said first colour (41).

[0132] Alternatively, the said layer (440) may be opaque (and preferably of said first colour), when the cell (415) is not connected to any electrical power source, becoming colourless, i.e., transparent, when said liquid crystal layer (440) is subjected to an electric field in response to the passage of an electrical current to said conductors (420) and (430) and/or when an electrical current flows through said layer (440), wherein said colour layer (441) comprises said second colour (42).

[0133] The said colour cell (415) further comprises a gap or clearance (450) at least between said colour layer (441) on said substrate (20) and said layer (440). Said clearance (450) substantially prevents the colour of said colour layer (441) showing through said liquid crystal layer (440), when opaque, which would be so to a significant degree at least, if the said liquid crystal layer (440) were in direct contact with said colour layer (441). Without said clearance, the said first and said second colours exhibited by the said cell (415) would not appear to be significantly different.

[0134] The conductors (420) and (430) are typically made from a transparent material, such as for example indium tin oxide or tin oxide.

[0135] Advantageously, the said display device for the colour cell shown in Figures 14 and 15 further comprises light scattering means superposed over the said liquid crystal layer (440), thereby improving the range of possible viewing angles. The said light scattering means may comprise a layer of water droplets (460) disposed over said liquid crystal layer and suitably electrically insulated therefrom, for example by means of a transparent insulating layer (470). Alternatively, the light scattering means may comprise a layer of light diffractive material comprising at least one and preferably a plurality of light scattering centers on its surface. Said light diffractive layer may comprise a relatively thin transparent plastic layer in which said light-scattering centres are each in the form of transparent substantially hemispherical protrusions, for example. Typically, said water droplets and said hemispherical protrusions are preferably not greater than the size of the cell (415).

[0136] At least the said base (110) of adjacent colour cells (415) are electrically insulated one from another. Such insulation may be achieved by means of an insulating material placed at least between the said corresponding conductors (420) and (430) of adjacent colour cells, or alternatively by means of a non-electrically-conductive space existing between at least the said corresponding conductors (420) and (430) of adjacent colour cells.

[0137] Also disclosed is a method for manufacturing the device (10) comprising said seventh disclosed colour cells (415) comprising steps of:-

(a) preparing a suitable substrate;

(b) printing a colour layer on said substrate;

(c) printing suitable spacers along the periphery of each cell;

(d) forming suitable substantially colourless electrical input means or electrical output means over said spacers using a paste mask method in which desired parts of a foil of suitable material superposed over said spacers is rendered, or remains conductive, while other parts remain, or are rendered, respectively, non-conductive;

(e) applying a layer of suitable liquid crystal material at least over said electrical input connection means or said electrical output connection;

(f) forming suitable substantially colourless electrical output means or electrical input means, respectively, over said liquid crystal material using a paste mask method.

Optionally, step (f) is followed by the following step:-

(g) aligning and suitably bonding a suitable layer of light diffractive material over said cells, such that at least one light-scattering centre is aligned over each said cell (415).

[0138] Thus, the structure of the colour cell (415) of the seventh embodiment is particularly suitable for enabling such cells to be manufactured layer by layer in a manner similar to that used in manufacturing printed circuits and integrated circuits and microchips, as well as by suitable printing methods.

[0139] Also disclosed herein is a picture display device comprising a suitable substrate carrying a plurality of colour cells wherein each colour cell is capable of exhibiting a change in its external colour from a first colour to a second colour, each said colour cell comprising:-

a layer of electrochromic material comprised on said substrate, said electrochromic material capable of changing

colour from said first colour to second colour in response to the passage of a suitable electrical current therethrough and/or the application of a suitable voltage thereto;

at least one pair of electrical conductors in electrical contact with said electrochromic layer, said pair of electrical conductors capable of being electrically connected to a suitable electrical power source and adapted to provide a suitable current and/or voltage to said electrochromic layer such as to enable said cell to exhibit a colour change from said first colour to second colour.

[0140] Thus, figures 16 and 17 disclose an eighth disclosed colour cell having a luminescent means comprising a layer of electrochromic material comprised on said substrate, said electrochromic material capable of changing colour from said first colour to second colour in response to the passage of a suitable electrical current therethrough and/or the application of a suitable voltage thereto; and furthermore, said suitable electrical connections comprises at least one pair of electrical conductors in electrical contact, with said electrochromic layer, said pair of electrical conductors capable of being electrically connected to a suitable electrical power source and being adapted to provide a suitable current and/or voltage to said electrochromic layer such as to enable said cell to exhibit a colour change from said first colour to second colour.

[0141] Referring to Figure 16, the said device (10) comprises a substrate (20), as hereinbefore described with reference to the preferred embodiment, *mutatis mutandis*, carrying a plurality of colour cells (815), wherein each colour cell (815) is capable of exhibiting a colour change in its external colour, said colour change being correlated to the passage of electrical current through the cell, or additionally or alternatively, to the application of electrical voltage across said colour cell (815). Each colour cell (815) comprises a layer of electrochromic material (840) comprised on said substrate, said electrochromic material capable of changing colour from said first colour to second colour in response to the passage of a suitable electrical current therethrough and/or the application of a suitable voltage thereto. The electrochromic layer (840) comprises at least one pair of electrical conductors (842), (844) in electrical contact with said electrochromic layer (840). The said pair of electrical conductors (842), (844) said pair of electrical conductors capable of being electrically connected to a suitable electrical power source. The electrochromic layer (840) comprises at least one pair of electrical conductors (842), (844) are typically opposed one to the other, as shown in Figure 16, or alternatively nested one within the other, and are adapted to provide a suitable current and/or voltage to said electrochromic layer (840) such as to enable said cell (815) to exhibit a colour change from said first colour to second colour. Typically, a reduction-oxidation reaction is initiated in the said cell (815) when electrical current is passed therethrough, resulting in a colour change from said first colour to said second colour. Said colour change is typically reversible when the current and/or voltage is turned off or alternatively reversed. The said eighth embodiment may be controlled by means of circuit boards (70) as hereinafter described with reference to the second embodiment, *mutatis mutandis*, wherein said electrical conductors (842), (844) may be considered synonymous with said input and output connection means, (120) and (130), respectively.

[0142] The structure of the colour cell (15, 15A), (115), (215), (315), 615), (515), (415) and (815), disclosed above of the preferred embodiment and the second, third, fourth, fifth, sixth, seventh or eighth disclosed colour cells respectively, are simple, thus enabling the colour cells, and thus the device (10) to be mass produced easily and relatively inexpensively. This leads to a very low unit cost per said device (10), significantly lower, by orders of magnitude, than other display devices known in the art. In fact the unit cost of such said display devices (10) is sufficient low to enable the said device (10) to be regarded as disposable, since it may be discarded after use with relatively negligible loss to the user.

[0143] Thus, as described above the display device (10) comprises a substrate (20) carrying a plurality of colour cells, (15, 15A), comprises a substrate (20) carrying a plurality of colour cells, (15, 15A), (115), (215), (315), (615), (515), (415) and (815), respectively. The colour cells, may be arranged in any convenient form on the substrate (20), and the colour cells themselves may also have any convenient shape. The colour cells on any particular device (10) may be homogeneously shaped, and at least some colour cells may optionally have a unique shape. For example, the colour cells may be rectangular or circular in shape, and they may then be conveniently arranged in the form of a substantially rectangular grid. Alternatively they may be hexagonally-shaped or in the shape of triangles and the cells may thus be conveniently arranged in the form of a substantially honeycomb-shaped grid. Likewise, circular-shaped cells may also be conveniently arranged in a honeycomb grid pattern. Alternatively, some of the colour cells may be arranged in groups of seven and appropriately shaped to form the known figure-"8" configuration, thus enabling digits from 0 to 9 to be displayed in the traditional manner.

[0144] Within the picture display device (10), the said colour cells may be conveniently divided into a first, a second and a third group, the said second colour (42) of the colour cells in said first group being of a red colour, the said second colour (42) of the colour cells of said second group being of a blue colour, and the second colour (42) of the colour cells in said third group being of a green colour. The said first colour (41) may be white or black, for example, or any other colour as desired by the user, or as appropriate to each application. Thus, when any of the colour cells of the

first group are activated, they exhibit a change in colour to red, while when any of the colour cells of the second and third group are activated they exhibit a change in colour to blue and green, respectively. Alternatively, the cells in each of the first, second and third groups may be configured so that the colour of the said second colour (42) of each group may comprise a different set of three colours, for example, yellow, magenta and cyan, or any other group of colours. This arrangement eventually allows colour pictures to be displayed by said display device (10). For monochromatic pictures, such division of the cells may not be necessary.

[0145] Advantageously, the colour cells comprising said three groups are substantially homogeneously distributed over the said substrate.

[0146] Typically, each said colour cell (15, 15A), (115), (215), (315), (615), (515), (415) and (815), described above, may have an equivalent diameter of between 0.1 mm and 1 meter, though the said equivalent diameter may alternatively be less than 0.1 mm or greater than 1 meter. Further, the colour cells on any one substrate need not all be the same size or shape. By equivalent diameter is meant the diameter of a round colour cell having the same area as the colour cell in question.

[0147] As hereinbefore described with reference to the colour cells described above, the display device (10) comprises a plurality of colour cells, (15, 15A), (115), (215), (315), (615), (515), (415) and (815), respectively, carried on a substrate (20). The colour cells are electrically connected, either directly or indirectly to a suitable electrical power source (99). The said power source may comprise a suitable DC battery, or additionally or alternatively a suitable photoelectric cell such as a solar cell, for example. Advantageously, the power source (99) is comprised on said substrate, and may be suitably printed on it in a manner known in the art, particularly in applications when the device (10) is manufactured using similar techniques used for manufacturing microprocessors as well as printed circuits.

[0148] Alternatively, the said power source (99) may comprise an AC power source, preferably operatively connected to a suitable rectifier.

[0149] While the following description is based on the colour cells (115) shown in Figures 4 and 5, it also applies to the other colour cells described herein *mutatis mutandis*.

[0150] The said power source (99) may be electrically connected to at least a portion of said colour cells (115) via a frame circuit board (70), said frame circuit board (70) being characterised in providing suitable interconnections between said power source (99) and the input and output connection means, (120) and (130) respectively, of each of the colour cells (115) of the said portion of colour cells. Said portion of colour cells may be chosen such that when the said colour cells of said portion of said colour cells are electrically connected to said power source a predetermined image comprised of each said second colour of each corresponding said colour cells of said portion of colour cells is exhibited by the said device.

[0151] Thus, any particular image may be created by the display device (10) by selectively activating some of the colour cells (115), while leaving others inactivated. The said frame circuit board (70) thus enables all the necessary colour cells (115) that are required to be activated to be simultaneously connected to the said power source (99) and thus create the image.

[0152] Optionally, some said frame circuit boards (70) may not provide any interconnections from the battery to the cells, thereby creating a "blank" image.

[0153] Referring to Figures 17 and 18, the device (10) is shown schematically as comprising only twelve colour cells (115) for the sake of simplicity. Of course, in practice the device (10) may comprise from one to virtually any number of colour cells (115) according to the application or need. The colour cells (115) are numbered herein 1 to 12, as illustrated, for convenience. One of the electrical connection means of each cell (115), say the output electrical connection means (130), is connected to a terminal or input/output line of a suitable electrical power source (99). The output connection means (130) of each cell (115) may be individually connected to the said negative terminal, or alternatively by means of one or more common output lines (95), as shown. The other electrical connection means of each cell (115), in this case the input connection means (120), may be electrically connected to corresponding input lines, designated (94_i), where the subscript "i" denotes the corresponding number of the colour cell (115), i.e., 1, 2, ..., 12. Said input lines (94_i) may be operatively connected to virtually any number of frame circuit boards (70), represented by the dotted lines in Figures 17 and 18, as, as hereinafter described.

[0154] The said frame circuit board (70) essentially comprises an electrical input line (72), connectable directly or indirectly to said power source (99), said input line (72) branching out, preferably by means of a common conducting element (79), into a number of output lines (73_i) (in the present example, from zero up to any combination of said twelve output lines (73₁) to (73₁₂)), where the subscript "i" denotes the corresponding number of the colour cell (115) to which the output line (73_i) will eventually be connected. Thus, for the purposes of example, frame circuit FX in Figure 17 comprises output lines (73₄), (73₁₁), (73₆) and (73₁), which are connected to colour cells 4, 11, 6 and 1, respectively, via lines (94₄), (94₁₁), (94₆) and (94₁), respectively as hereinafter described.

[0155] In Figure 17, the input lines (94_i) are connected in parallel to successive groups (A), (B), (C), ..., (X) of terminals or conductors. Thus, each said group (A), (B), (C), ..., (X), comprises (in the present example) 12 terminals or conductors (96₁) to (96₁₂) which are connected to the input lines (94₁) to (94₁₂), respectively.

[0156] Thus, the output lines (73_i) for each frame circuit board (70) are connected to the corresponding terminals or conductors (96_i) of the corresponding group (A), (B), (C)...(X) of terminals or conductors. Thus, in the case of frame circuit FX referred to above, output lines (73₄), (73₁₁), (73₆) and (73₁), are connected to colour cells 4, 11, 6 and 12, respectively, via terminals or conductors (96₄), (96₁₁), (96₆) and (96₁), respectively, and lines (94₄), (94₁₁), (94₆) and (94₁), respectively as herein described.

[0157] In the device of Figure 18, the output lines (73_i) of each frame circuit board (70) is directly connected to the corresponding input line (94_i).

[0158] The device shown in Figure 17 provides any number of groups of terminals or conductors (96_i), each group potentially connecting all the cells (115) of the device (10) to any particular frame circuit board. As such, this arrangement enables one design of input lines (94_i) and corresponding groups of terminals or conductors (96_i) to be designed for use with any number of different frame circuit boards (70), each comprising any desired combinations of lines (73_i).

[0159] The device of Figure 18, while perhaps less versatile than that of Figure 17 and requiring that all the connections from each frame circuit board (70) to be predetermined, it is nonetheless simpler and more spatially economical, resulting in the device (10) being more compact.

[0160] Also disclosed is a sequencing means which are novel per se and which enable electrical contact to be established between successive pairs of electrical contacts of a series of consecutive pairs of electrical contacts. Typically, establishing electrical contact with each said pair of contacts closes a unique electrical or electronic circuit.

[0161] The sequencing means (60) enables the said power source (99) to be selectively connected to only one of a plurality of said frame circuit boards (70) at a time via the corresponding input line (72) thereof. The sequencing means (60) may be configured to connect the power source (99) to any particular one of the said frame circuit boards (70) on demand by a user, and may comprise, for example, a series of suitable discrete on/off switches (each switch operatively connected to a corresponding frame circuit board (70) and preferably operable by a user of the device), enabling the user to connect any particular frame circuit board (70) to the power source (99). Alternatively or additionally, the sequencing means (60) may be configured to connect the power source (99) to any number of the said frame circuit boards (70) in a predetermined sequence.

[0162] In particular, the said sequencing means (60) electrically connects said power source (99) to each successive frame circuit board (70) of said plurality of frame circuit boards of a predetermined sequence at a predetermined rate. Said predetermined rate may be between about 1 and about 30 frame circuit board connections per second, and preferably about 15 frame circuit board connections per second. Nonetheless, the said rate may be greater than 30 or lower than 1 frame circuit board connections per second.

[0163] As described above, each said frame circuit board (70) may be configured such as to enable a predetermined image to be exhibited by the said device (10), by appropriately choosing which of the colour cells (115) to activate simultaneously. The said predetermined images corresponding to consecutive frame circuit boards (70) may be chosen such as to produce an illusion of movement of an image in correlation to the sequential connection of said plurality of frame circuit boards (70) to said power source (99) by means of said sequencing means (60).

[0164] The said sequencing means (60) may further operate in consecutive cycles, whereby in each said cycle the said sequencing means (60) electrically connects said power source (99) to each said frame circuit board (70) of said plurality of frame circuit boards (70) in said predetermined sequence.

[0165] Optionally, said sequencing means may comprise a suitably programmed microprocessor chip.

[0166] Also disclosed is a first switch for electrically connecting between at least one pair of electrical conductors comprising:-

a suitable substantially non-electrically-conducting fluid medium in the form of a closed loop and having a free upper surface;

said closed loop bounded by at least an inner wall and an outer wall, said inner and outer walls being substantially concentric one to the other and comprising an upper inner wall portion and an upper outer wall portion, respectively, protruding from the mean level of the said fluid free surface;

at least one said pair of conductors, one said conductor of said pair comprising a suitable first electrical contact on said upper inner wall portion, and the other said conductor comprising a suitable second electrical contact on said upper outer wall portion;

at least one electrically actuable oscillating element immersed in said fluid medium capable of providing at least one travelling wave on said free surface in response to suitable vibrations thereof;

an electrically-conductive dynamic contact element, substantially on said free surface and capable of being carried by said wave, said contact element extending at least between said first electrical contact and said second electrical

contact;

whereby when said oscillating element is suitably vibrated, at least one travelling wave is provided on said free surface carrying the said dynamic element along said free surface element alternately to a position providing electrical contact between said first contact and said second contact and to a position in which said first contact and said second contact are electrically disconnected.

[0167] In particular, one conductor of said pair is electrically connectable to a suitable power source and the other conductor of said pair is connectable to a corresponding frame circuit board.

[0168] Optionally, said first contact and said second contact of each said pair of conductors are substantially facing one another.

[0169] Optionally, said first switch comprises a plurality of said pairs of conductors, and optionally the said first contact of each of said plurality of said pairs of conductors are electrically interconnected. Further, the said first contact of each of said plurality of said pairs of conductors may be in the form of a suitable single electrical contact. In particular, said single electrical contact may be in the form of a conducting band on said upper inner wall portion.

[0170] Optionally, the said second contact of each of said plurality of said pairs of conductors are electrically interconnected, and optionally said second contact of each of said plurality of said pairs of conductors are in the form of a suitable single electrical contact. Further, said single electrical contact is in the form of a conducting band on said upper outer wall portion.

[0171] Thus, with reference to Figure 19, a first sequencing means (60) comprises a first switch (610). Said first switch (610) comprises a channel (611) which is in the form of a closed loop, and in particular a smoothly contoured closed loop. Preferably, said channel (611), and therefore the closed loop, is substantially annular, typically flanked by an inner substantially cylindrical wall (633) having an upper wall inner wall portion (613) and an outer substantially cylindrical wall having an upper outer wall portion (612), and a further comprising a substantially annular base (617) extending between the lower parts of said inner wall portion (613) and said outer wall portion (612). Alternatively, the said channel (611) may be substantially circular, elliptical, superelliptical, polygonal or any other suitable shape. The cross-section of the channel (611), i.e., of each arm thereof, is typically substantially rectangular, but may be partially circular, semicircular, U-shaped, semielliptical partially elliptical or any other suitable shape providing a reasonable free surface (622).

[0172] The said channel comprises a substantially non-electrically-conducting fluid medium (621), typically a liquid, having a free upper surface (622). Said fluid medium (621) may comprise, for example oil. An oscillating element (623) connected to a suitable power source (98) is immersed in said liquid medium (621). Typically, said oscillating element (623) comprises a suitably configured piezoelectric crystal, but may alternatively comprise any material which is capable of vibrating when acted on by an electric current, for example a suitable gel or a Polyacrilamid material. The oscillating element (623) is characterised in being able to produce a travelling wave or waves on the free surface (622) of the liquid medium (621) along a desired direction. The oscillating element (623) is operatively connectable to a suitable electrical power source.

[0173] The shape of the oscillating element (623) where appropriate is preferably chosen to be complementary with the cross-sectional shape of the channel (611). The said inner wall (633), outer wall (632) and base (617) may be made from any suitable plastic or any other suitable material, preferably as an integrated molded component. Alternatively, the said inner wall (633), outer wall (632) and base (617) may be integrated in the topography of a microprocessor circuit, for example, where appropriate.

[0174] Said inner wall portion (613) comprises a first series of inner contact points at least above the level of the said free surface (622). Advantageously, if said first series of inner contact points are all to be ultimately connected to the same electrical point, for example one terminal of an electrical power source (99), said series of inner contact points are cross-connected and comprise a conducting ring (626) on said inner wall portion (613) said ring (626) being at least above the level of the said free surface (622). Said outer wall portion (612) comprises a second series of outer contact points (627) at least above the level of the said free surface (622), each of said outer contact points (627) being connectable to an electrical or electronic circuit. In particular, the said outer contact points (627) may be electrically connected one each to the said input line (72) of a corresponding frame circuit board (70).

[0175] The said first switch (610) further comprises a dynamic contact element (625) on said free surface (622) for establishing contact between the said conducting ring (626) (or each corresponding inner contact points) and each of the said outer contact points (627) in turn. Said dynamic contact element (625) is made from an electrically-conductive material, having physical properties enabling the said contact element (625) to remain substantially on the free surface (622). The said dynamic contact element (625) may comprises any suitable liquid, solid or hollow solid, and is preferably in the form of a droplet, bubble or any suitable form including from substantially spherical through substantially cylindrical, floating on said liquid medium (621) while in contact with said inner wall portion (613) and said outer wall portion (612), in particular, ring (626) and said outer contact points (627). Thus, the said contact element (625) may comprise, for example a droplet of non-distilled water, mercury, or a droplet of any other suitable conducting liquid. Typically, said

contact element (625) is of a lower density than the said liquid medium (621). Nonetheless, the density of the contact element may be substantially equal to or greater than that of the liquid medium (21), in which case the said contact element may still remain substantially on the surface (622) due to other physical considerations such as, for example, surface tension effects.

5 [0176] When an electrical current activates the said oscillating element (625), it begins to vibrate in a predetermined manner in order to produce waves on the said free surface (622) which travel around the said channel (611) in a predetermined direction and speed. The travelling waves carry the said contact element (625) around the said channel sequentially establishing contact between said conducting ring (626) (or each corresponding inner contact points) and each one of the said outer contact points (627) in turn.

10 [0177] Thus, when the said outer contact points (627) are electrically connected to the said input line (72) of corresponding frame circuit boards (70), and the said conducting ring (626) is connected to the said power source (99) as hereinbefore described, the said first switch (610) enables a series of frame circuit boards (70) to each be individually connected to the power source (99) in a consecutive manner, and thus provide the illusion of a moving image on said device (10), as described hereinbefore. Moreover, since the said channel (611) is in the form of a closed loop, the traveling wave created by the said oscillating element (621) travels around the channel in endless loops until the oscillating element (621) is deactivated, and thus the said frame circuit boards (70) are correspondingly cyclically connected to said power source (99) by the first switch (610).

15 [0178] The first switch (610) may be configured to produce a travelling wave having a velocity such that contact between the conducting ring (626) (or each corresponding inner contact points) and each consecutive outer contact points (627) is established every 1/15 of a second, for example. Optionally, the first switch (610) may also be configured to produce a single or a group of travelling waves such that contact between the conducting ring (626) (or each corresponding inner contact points) is only established with one consecutive outer contact points (627) and maintained there until the next activation of the oscillating element (621).

20 [0179] While the overall diameter of the switch may be virtually of any size, the width (W) of the channel (611) between the said inner wall portion (613) and outer wall portion (612), particularly at the level of said surface (622) is typically between about 0.1mm and about 10mm, and preferably about 1 mm.

25 [0180] Also disclosed is a second switch for electrically connecting between at least one pair of electrical conductors comprising:-

30 an inner substantially non-electrically-conducting ring and an outer concentric substantially non-electrically-conducting ring;

at least one said pair of conductors, one said conductor of said pair comprising a suitable first electrical contact on said inner ring, and the other said conductor comprising a suitable second electrical contact on said outer ring;

35 an electrically-conductive dynamic contact element, substantially extending at least between said first electrical contact and said second electrical contact;

40 a suitable motor suitably operatively connected to at least one of said inner ring, said outer ring and said contact element such as to provide relative rotational motion between said contact element and at least one of said inner ring and said outer ring;

45 whereby when said motor provides suitable relative rotational motion between said contact element and at least one of said inner ring and said outer ring, the said dynamic element is brought alternately to a position providing electrical contact between said first contact and said second contact and to a position in which said first contact and said second contact are electrically disconnected.

[0181] In particular, one conductor of said pair may be electrically connectable to a suitable power source and the other conductor of said pair may be connectable to a corresponding frame circuit board.

50 [0182] Optionally, said first contact and said second contact of each said pair of conductors are substantially facing one another.

[0183] Optionally, said second switch comprises a plurality of said pairs of conductors.

55 [0184] Optionally the said first contact of each of said plurality of said pairs of conductors may be electrically interconnected. Further, the said first contact of each of said plurality of said pairs of conductors may be in the form of a suitable single electrical contact. In particular, said single electrical contact may be in the form of a conducting band on said inner ring.

[0185] Optionally, the said second contact of each of said plurality of said pairs of conductors are electrically interconnected, and optionally the said second contact of each of said plurality of said pairs of conductors are in the form of a suitable single electrical contact. Further, said single electrical contact is in the form of a conducting band on said

outer ring.

[0186] Thus, with reference to Figure 20, a second disclosed sequencing means (60) comprises a second switch (710). Said second switch (710) comprises a flat motor (750) operatively connected to a suitable power source (97), which may be the same power source (99) of the said device (10), said motor (750) operating by means of a suitably configured piezoelectric crystal, for example. Such flat motors are well-known in the art. The second switch (710) further comprises an inner ring (735) and an outer substantially coplanar concentric ring (725), each ring (725), (735) comprising a series of contact points, (720) and (730), respectively.

[0187] The motor (750) provides suitable relative rotational motion between a contact element (770) and at least one of said inner ring (735) and said outer ring (725), and the said dynamic element (770) is brought alternately to a position providing electrical contact between said first, or inner, contact point (730) and said second, or outer, contact point (720) and to a position in which said first contact point (730) and said second contact point (720) are electrically disconnected.

[0188] Thus, the said dynamic contact element (770) may be relatively static, wherein the said inner ring (735) and outer ring (725) may rotate at substantially equal angular velocities. Optionally, where said series of said outer contacts (720) may be interconnected and comprise, for example, a single conducting ring which is always in contact with said conducting element (770), the said inner ring (735) may be rotated by means of said motor (750), while the outer ring (725) and the said contact element (770) remain substantially static. Alternatively, said series of said inner contacts (730) may be interconnected and comprise, for example, a single conducting ring which is always in contact with said conducting element (770), wherein the said outer ring (725) may be rotated by means of said motor (750), while the inner ring (735) and the said contact element (770) remain substantially static.

[0189] Preferably, said inner ring (735) and said outer ring (725) are substantially static, and said dynamic element (770) is suitably carried on a rotor arm (760) operatively connected to said motor capable of rotating about the common axis of said inner ring (735) and said outer ring (725). The contact points (720) and (730) are arranged in pairs such that the inner contact point (730) and the outer contact point (720) of each said pair may be electrically connected by means of said contact element (770). Thus, if the said rotor arm (760) extends radially from the axis of rotation of same, the contacts (720) and (730) of each said pair are disposed at substantially identical angular dispositions on said rings (725) and (735), respectively.

[0190] Thus, when the motor (750) rotates the rotor arm (760), the conducting element (770) establishes contact with each pair of contact (720), (730), successively, breaking contact between each previous pair before establishing contact with each subsequent pair, by means of suitable non-conducting spaces (727), (737) between adjacent contacts (720), (730), respectively, in each said ring (725), (735) respectively.

[0191] Preferably, said dynamic contact element (770) comprises a suitable electrical conductor.

[0192] Where appropriate, either said series of said outer contacts (720) or said series of said inner contacts (730) may be interconnected and comprise instead a single conducting ring which is always in contact with said conducting element (770).

[0193] Each of the outer contact (720) and each corresponding inner contact (730) are connectable to an electrical or electronic circuit. In particular, each of said outer contact (720) may be electrically connected to the said input line (72) of each corresponding frame circuit board (70), and the corresponding inner contact (730) of each said pair (or equivalent conducting ring) is connectable to said power source (99). Alternatively, each of said inner contact (730) may be electrically connected to the said input line (72) of each corresponding frame circuit board (70), and the corresponding outer contact (720) of each said pair (or equivalent conducting ring as hereinbefore described) is connectable to said power source (99).

[0194] The second switch (710) may be configured to enable said rotor arm (760) to rotate about the motor axis at a velocity such that contact between each consecutive pair of inner contact (730) and outer contact (720) is established every 1/15 of a second, for example. Optionally, the said second switch (710) may also be configured to enable the rotor arm (760) to establish contact with one said pair of outer contact (720) and (730), remaining there until the next activation of the motor (750).

[0195] Further, since the motor enables the rotor arm (760) to rotate substantially endlessly about its axis until the motor (750) is deactivated, each consecutive pair of contacts (720) and (730) is electrically interconnected in corresponding cycles. Thus where each of the said frame circuit boards (70) of a plurality of frame circuit boards is connected to one of said contacts (720) or (730) of a said pair, and the other contact (730) or (720), respectively, is connected to said power source (99), the conducting element (770) on the rotor arm (760) interconnects the power source (99) to each consecutive frame circuit board (70) cyclically.

[0196] Also disclosed is a third switch for electrically connecting between a first electrical conductor and a plurality of electrical output conductors comprising:-

a base;

a plurality of suitable bimetallic strips, each said bimetallic strip being suitably attached at a first end thereof to said base, said bimetallic strips being reversibly deformable from a first configuration to a second configuration in response to at least a predetermined change in temperature of said bimetallic strip, such that the second end of each said bimetallic strip is correspondingly displaced from a first position to a second position, respectively;

a first electrical conductor electrically connected at least to each said first ends of said bimetallic strips;

a second electrical conductor spaced from said base, said second end of each said bimetallic strip being substantially free to reciprocate between said first position and said second position, respectively capable of establishing and breaking electrical contact between said bimetallic strip and said second electrical conductor;

said first electrical conductor and said second electrical conductor being operatively connectable to a suitable electrical power source;

said bimetallic strips being electrically heatable to at least to said predetermined change in temperature when said second ends thereof are in electrical contact with said second conductor;

a plurality of electrical output conductors, wherein each said output conductor is suitably disposed with respect to said second end of a corresponding said bimetallic strip such that said output conductor may be brought into common electrical contact with said corresponding bimetallic strip and said second conductor only when said corresponding bimetallic strip is in electrical contact with said second conductor;

characterised in that the heating and/or cooling rates of at least one of the said plurality of bimetallic strips may be different from the heating and/or cooling rates, respectively, of at least one other bimetallic strip, wherein said difference in heating and/or cooling rates enables at least one said output conductor to be electrically connected to a corresponding bimetallic strip and said second conductor while at least another said output conductor is concurrently electrically disconnected from its corresponding bimetallic strip and said electrical conductor.

[0197] In particular, said first electrical conductor are electrically connectable to a suitable power source and each said electrical output conductor are connectable to a corresponding frame circuit board.

[0198] Thus, with reference to Figure 21, a third sequencing means (60) comprises a third switch (810), comprising a series of "n" bimetallic strips (850_i) to (850_n) each bimetallic strip (850_i) being bonded at a first end (871) thereof to a common base (860), and having as a common electrical input (or output) line first electrical conductor (820). Optionally, said first electrical conductor (820) and said base (860) are integral. The second end (872) of each bimetallic strip (850_i) is free, and the bimetallic strips (850_i) are all configured having a datum (cold) configuration in which all the said strips (850_i) are in contact with a second electrical conductor (830). Preferably, each bimetallic strip (850_i) comprises an output conductor (82) capable of being connected to an independent circuit, in particular, to any particular frame circuit board (70) via the corresponding said conductor (72) thereof. Alternatively, said output conductor (82) may be disposed in relation to said second electrical conductor (830) and said second end (872) of each corresponding strip (850_i) such that the when strip (850_i) is in electrical contact with said second electrical conductor (830), it is also in electrical contact with said corresponding output conductor (82); likewise, electrical contact between said output conductor (82) and said strip (850_i), and between said strip (850_i) and said second electrical conductor (830) is substantially simultaneous. Said first electrical conductor (820) and second electrical conductor (830) are electrically connected to a suitable power source (99), the flow of current through the bimetallic strips (850_i) heating the same and causing each one thereof to bend away from the said second electrical conductor (830) and ultimately break contact therewith. Optionally, each said strip (850_i) may comprise a heating element which may be heated electrically when said strip (850_i) is electrically connected to said second electrical conductor (830). As each bimetallic strip (850_i) breaks contact with the second electrical conductor (830), the strip (850_i) immediately begins to cool, and eventually returns to its original position reestablishing contact with said second electrical conductor (830). The cycle is repeated endlessly until the power source (99) is disconnected from the said first electrical conductor (820) or second electrical conductor (830). Whenever any said bimetallic strip (850_i) is in contact with said second electrical conductor (830), the corresponding conductor (82) of the bimetallic strip (850_i) enables a corresponding external circuit to be closed, in particular connecting a corresponding frame circuit board (70), to the power source (99).

[0199] The said bimetallic strips (850_i) are characterised in that each strip (850_i) has different heating and cooling rates one from the other strips (850_j), said bimetallic strips (850_i) being preferably arranged on said first electrical conductor (820) in descending order with respect to heating and cooling rates. In other words, the last bimetallic strip (850_n) has a slower heating and cooling rate than its neighbour strip (850_{n-1}), than its neighbour (850_{n-2}) and so on until the first bimetallic strip (850₁), which has the highest heating and cooling rate. Alternatively, the bimetallic strips (850_i) may be arranged in any order whatsoever, in terms of their relative heating and/or cooling rates. The differences

in the heating and cooling rates between each of the bimetallic strips (850_i) may be achieved, for example, by correspondingly altering the thickness or width of each strip (850_i).

[0200] Thus, when the said power source (99) is electrically connected to said conductors (820) and (830), initially all the strips (850_i) are in contact with the second electrical conductor (830) and begin to heat up. At the same time, the individual frame circuit boards (70) connected to the corresponding strips (850_i) are activated by closing the circuits between said frame circuit board and the power source (99), thereby activating all the cells (115) of the device (10), as defined by the sum of all the conductors (73_i) of all the frame circuit boards (70). The resulting image is thus a superposition of all the images together corresponding to the frame circuit boards (70). As the bimetallic strips (850_i) heat up, the first strip (850₁) disconnects first from the second electrical conductor (830), followed by the second strip (850₂) and so on up to the last strip (850_i). The strips (850_i) are also characterised in that the heating and cooling rates of each strip (850_i) in relation to the corresponding rates of another strip, for example an adjacent strip (850_{i+1}) or (850_{i-1}) are such that after all the strips (850_i) are initially heated and disconnected from the said second electrical conductor (830), only one strip (850_i) at any one time reconnects with said second electrical conductor (830). Thus, after all the strips have been initially heated and disconnected from the second electrical conductor (830), the first bimetallic strip (850₁) has been cooling down the longest and reestablishes contact with the second electrical conductor (830), thus activating a frame circuit board (70) connected to the strip (850₁) via conductor (82). On reestablishing contact with second electrical conductor (830), the strip (850₁) begins to heat again and disconnects from the conductor (830), also disconnecting the corresponding (first) frame circuit board (70) from the power source (99). By this time, the second strip (850₂) reestablishes contact with the conductor (830), enabling the second frame circuit board (70) to be activated, the strip (850₂) itself becoming heated and subsequently disconnecting from the second electrical conductor (830). Similarly, each strip (850_i) in turn connects to and subsequently disconnects from the second electrical conductor (830), according to the order of the relative heating and cooling rates of the strips (850_i), which is not necessarily the order in which the strips (850) are arranged in said third switch (810), enabling each subsequent frame circuit board (70) to be activated in turn. By the time the last of the strips (850_i) connects with and disconnects from the said second electrical conductor (830), the first strip (850₁) has cooled down sufficiently to reestablish contact with the second electrical conductor (830), beginning a new cycle. Optionally, the heating and cooling rates of the said strips (850_i) may be chosen so that there is a certain "overlap" in the image displayed by the device (10) between a preceding and a subsequent image, in that the corresponding strips (850_i) are simultaneously connected at least for a predetermined length of time before one of the said strips (850_i) disconnects from said second electrical conductor (830).

[0201] Optionally, the said first electrical conductor (820) and said second electrical conductor (830) are substantially parallel. Further optionally, said plurality of bimetallic strips (850_i) are substantially parallel one to another.

[0202] Optionally, the said third switch (810) may further comprise at least one common bimetallic strip (880) connected in series with the said first electrical conductor (820) and/or said second electrical conductor (830). Initially, the common bimetallic strip (880) is in contact with the said first electrical conductor (820) or second electrical conductor (830), enabling current to flow through the said third switch (810), but when heated sufficiently, the common bimetallic strip (880) breaks contact with the first electrical conductor (820) or second electrical conductor (830), thereby effectively disconnecting the said third switch (810) from the power source (99). The heating and cooling rate of the said common bimetallic strip (880) is preferably chosen such as to enable the said common bimetallic strip (880) to remain in contact with the said first electrical conductor (820) or second electrical conductor (830), until the end of one cycle, as hereinbefore described. Thus, said at least common bimetallic strip has a heating rate which is substantially slower than the heating rate of any one of said plurality of bimetallic strips, and preferably also a cooling rate which is substantially slower than the heating rate of any one of said plurality of bimetallic strips.

[0203] The said common bimetallic strip (880) disconnects the power source (99) from the said third switch (810), enabling all the strips (850_i) to cool down and resume contact with the said second electrical conductor (830), after which the common bimetallic strip (880) itself cools down and reconnects the power source (99) to the said third switch (810) to begin a new cycle.

[0204] Also disclosed is a fourth switch for electrically connecting between a first electrical conductor and a plurality of electrical output conductors comprising:-

a base;

a plurality of suitable piezoelectric elements, each said piezoelectric element being suitably attached at a first end thereof to said base, each said piezoelectric element being vibratory between a first amplitude and a second amplitude in response to the supply of a suitable electrical current and/or voltage to said piezoelectric element, such that the second end of each said piezoelectric elements is correspondingly displaced from a first position to a second position, respectively;

a first electrical conductor electrically connected at least to each said first ends of said piezoelectric elements;

a second electrical conductor spaced from said base, said second end of each said piezoelectric elements being substantially free to reciprocate between said first position and said second position, respectively capable of establishing and breaking electrical contact between said piezoelectric elements and said second electrical conductor;

said first electrical conductor and said second electrical conductor being operatively connectable to a suitable electrical power source;

said piezoelectric elements being vibratory when said second ends thereof are in electrical contact with said second conductor;

a plurality of electrical output conductors, wherein each said output conductor is suitably disposed with respect to said second end of a corresponding said piezoelectric element such that said output conductor may be brought into common electrical contact with said corresponding piezoelectric element and said second conductor only when said corresponding piezoelectric element is in electrical contact with said second conductor;

characterised in that the phase of vibration of at least one of the said plurality of piezoelectric elements may be different from the phase of vibration of at least one other piezoelectric element, wherein said phase difference enables at least one said output conductor to be electrically connected to a corresponding piezoelectric element and said second conductor while at least another said output conductor is concurrently electrically disconnected from its corresponding piezoelectric element and said electrical conductor.

[0205] In particular, said first electrical conductor is electrically connectable to a suitable power source and each said electrical output conductor is connectable to a corresponding frame circuit board.

[0206] Thus, with reference to Figure 22, a fourth sequencing means (60) comprises a fourth switch (910), comprising a series of "n" piezoelectric elements (950_i) to (950_n) in the form of relatively thin strips, each piezoelectric element (950_i) being bonded at a first end (971) thereof to a common base (960), and each piezoelectric element (950_i) having a conductor (940_i) connected to a common electrical input (or output) line or first electrical conductor (920). Preferably, said first electrical conductor (920) and said base (960) are integral. The second end (972) of each piezoelectric element (950_i) is free, and the piezoelectric elements (950_i) are all configured having a datum (unexcited) configuration in which all the said piezoelectric elements (950_i) are in contact with a second electrical conductor (930). Preferably, each piezoelectric element (950_i) comprises an output conductor (92) capable of being connected to an independent circuit, in particular, to any particular frame circuit board (70) via the corresponding said conductor (72) thereof. Alternatively, said output conductor (92) may be disposed in relation to said second electrical conductor (930) and said second end (972) of each piezoelectric element (950_i) such that the when piezoelectric element (950_i) is in electrical contact with said second electrical conductor (930), it is also in electrical contact with said corresponding output conductor (92); likewise, electrical contact between said output conductor (82) and said piezoelectric element (950_i), and between said piezoelectric element (950_i) and said second electrical conductor (930) is substantially simultaneous. Said first electrical conductor (920) and second electrical conductor (930) are electrically connected to a suitable power source (99), the flow of current through the piezoelectric elements (950_i) exciting the same and causing each one thereof to bend away from the said second electrical conductor (930) and ultimately break contact therewith. As each piezoelectric element (950_i) begins to oscillate, it alternately breaks contact with the second electrical conductor (930) and returns to its original position reestablishing contact with said second electrical conductor (930). The cycle is repeated endlessly until the power source (99) is disconnected from the said first electrical conductor (920) or second electrical conductor (930). Whenever any said piezoelectric element (950_i) is in contact with said second electrical conductor (930), the corresponding conductor (92) of the piezoelectric element (950_i) enables a corresponding external circuit to be closed, in particular connecting a corresponding frame circuit board (70), to the power source (99).

[0207] Optionally, said first electrical conductor (920) and said second electrical conductor (930) are substantially parallel. Further optionally, said plurality of piezoelectric elements (950_i) are substantially parallel one to another.

[0208] The oscillation rates of all the piezoelectric elements (950_i) are set to be substantially equal, so that they all take the same time to connect to the said second electrical conductor (930), as well as to disconnect therefrom.

[0209] Further, the period of time in which each piezoelectric element (950_i) is disconnected from said second electrical conductor (930), i.e., the disconnect time (T1), is typically set to be greater than the period of time in which each piezoelectric element (950_i) is connected to said second electrical conductor (930), i.e., the connect time (T2).

[0210] The piezoelectric elements (950_i) are advantageously configured such that the disconnect time (T1) is equal or greater than the sum total of the connect times (T2) of all the piezoelectric elements (950_i) in the said fourth switch (910), in other words:-

$$T1 \geq (n \cdot T1)$$

[0211] Thus, the said fourth switch may be configured so that after the first piezoelectric element (950_1) connects to and subsequently disconnects from said second electrical conductor (930), each subsequent piezoelectric element (950_i) begins its connect disconnect cycle just after disconnection of the preceding piezoelectric element (950_{i-1}), such that at any one time not more than one piezoelectric element (950_i) is connected to the said second electrical conductor (930). Nonetheless, the disconnect time ($T1$) may be set to be smaller than the sum total of the connect times ($T2$), providing is a certain "overlap" in the image displayed by the device (10) between a preceding and a subsequent image, in that the corresponding piezoelectric elements (950_i) are simultaneously connected to said second electrical conductor (930) at least for a predetermined length of time before one of the said piezoelectric elements (950_i) disconnects from said second electrical conductor (930).

[0212] Such an arrangement regarding the relative start times for the oscillations i.e., the difference in phase of vibration between adjacent piezoelectric elements, may be achieved by live-connecting the said power source (99) to said first ends (971) of said plurality of piezoelectric elements (950_i) at a predetermined rate. Thus, during the last stages of manufacture of the said fourth switch (910), each of the piezoelectric elements (950_i) is bonded to said common base (960) and is in contact with said second electrical conductor (930). The power source (99) is then connected to said second electrical conductor (930), and then first electrical conductor (920) is formed on said base (960), such that the first electrical conductor (920) successively establishes contact with each subsequent piezoelectric element (950_i) of the fourth switch (910) while the said first electrical conductor (920) is live, i.e., all the time connected to the power source (99). This may be achieved by suitable printing methods, for example, in which the electrical conductor (920) is printed in the form of a conducting ink on said base (960) by means of a suitable applicator, such that the connection of first electrical conductor (920) to each successive piezoelectric element (950_i) occurs at a particular time interval after the connection of the preceding piezoelectric element (950_{i-1}). Thus, when connection is initially established between the said first electrical conductor (920) and the first piezoelectric element (950_1), via the corresponding conductor (940_1), the said first piezoelectric element (950_1) begins its oscillation cycles and continues until, typically, the power source is disconnected or is exhausted. The first electrical conductor (920) is then continued to be formed on the said base (960) such as to reach and establish contact with each subsequent piezoelectric element (950_i) at a certain time interval ΔT after having established contact with the previous piezoelectric element (950_{i-1}). The interval ΔT is advantageously chosen to be not smaller than the time taken by the preceding piezoelectric element (950_i) to disconnect from the said second electrical conductor (930). In this way, the piezoelectric elements (950_i) all have oscillation start times which are slightly delayed with respect to the preceding piezoelectric element (950_{i-1}). Since the disconnect time ($T1$) of each of the piezoelectric elements (950_i) is greater than the sum total of the connect times ($T2$) of all "n" piezoelectric elements (950_i), the first piezoelectric element (950_1) once connected to the power source (99) via said first electrical conductor (920), will not reestablish contact with said second electrical conductor (930) until at least the last piezoelectric element (950_n) has been disconnected from the said second electrical conductor (930), thereby commencing another cycle. Alternatively, said time interval ΔT may be chosen in order to create any desired degree of overlap between some or all consecutive images, as hereinbefore described, for example.

[0213] Thus, once the common line first electrical conductor (920) has been connected to all the piezoelectric elements (950_i), each one of said piezoelectric elements (950_i) will be in turn connected to said second electrical conductor (930), thus activating a corresponding frame circuit board (70) connected to the piezoelectric element (950_i) via conductor (92).

[0214] The structure of the first, second, third, and fourth sequencing means described above, respectively, thereof is thus relatively simple, enabling the sequencing means (60), and thus also the device (10) incorporating the same to be mass produced easily and relatively inexpensively. This leads to a very low unit cost per said sequencing means (60) and/or said device (10), significantly lower, by orders of magnitude, than other display devices known in the art. In fact the unit cost of such said sequencing means (60) individually or incorporated in said display devices (10) is sufficient low to enable the said sequencing means (60), as well as said device (10) incorporating same, to be regarded as disposable, since it may be discarded after use with relatively negligible loss to the user.

[0215] The picture display device (10) according to any one of the devices described herein may be used in any number of applications, including the following applications, for example.

[0216] The said device (10) according to any one of the devices described herein may be attachable to an article of manufacture or to packaging means, in particular, wherein said device is integral with said packaging means.

[0217] Optionally, the said device (10) according to any one of the devices described herein may further comprise suitable interface means for using said device as a suitable display screen optionally for use with a computer, television/video means or telephone means. Such an interface would enable the display signals from the computer, television/video means or telephone means to be converted to a form compatible for use with the device (10). For example, with respect to a device (10) comprising cells (15) and/or (15A) wherein the cells (15) and/or (15A) are controlled by means

of input lines (L1) and (L2), and a microprocessor (91) as hereinbefore described, the interface would serve to control the voltage and/or current to these lines according to the image being displayed, given the particular format of the display signals received from the computer, television/video means or telephone means, the said format being preprogrammed into the interface. For said device (10) comprising the colour cells described above, the interface comprises all necessary connections to all the cells of the device (10), and further controls the voltage and/or current to each cell according to the image being displayed, given the particular format of the display signals received from the computer, television/video means or telephone means, the said format being preprogrammed into the interface.

[0218] Optionally, the said device (10) according to any one of the devices described herein may further comprise suitable chronometer suitably configured such as to enable said device to display images corresponding to normally-printed matter, i.e. textual and image material that is normally or predominantly found in printed form, including texts and pictures. Such normally-printed matter may include any book, newspaper, magazine, booklet, manual, greeting card, personal card, seasonal card, visiting card, advertisement card, postage and other stamp, postcard, sticker, label, poster, banner, flag, emblem, badge, prospectus, illustration guide, map, picture, and printed propaganda, among others.

[0219] Optionally, the device (10) according to any one of the devices described herein may further comprise suitable chronometer means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display images corresponding to the time and/or the date. Such chronometer means advantageously comprises an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0220] Optionally, the said device (10) according to any one of the devices described herein may further comprise suitable meter means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display images corresponding to the magnitude of a variable quantified by said meter. Such meter means advantageously comprises an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0221] Optionally, the said device (10) according to any one of the devices described herein may further comprise suitable chronometer means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display different images according to the current to the time and/or the date. Such chronometer means advantageously comprises an interface means for connecting to and controlling the frame circuit cards of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0222] Optionally, the said device (10) according to any one of the devices described herein may be suitably configured as a traffic or road sign. Such traffic or road signs advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0223] Optionally, the said device (10) according to any one of the devices described herein may be adapted for use as a lottery ticket. Such lottery tickets advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0224] Optionally, the said device (10) according to any one of the devices described herein may be adapted for use as a credit card. Such credit cards advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0225] Optionally, the said device (10) according to any one of the devices described herein may be adapted for use as an identity card or identity document. Such ID cards or identity document advantageously comprises an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0226] Optionally, the said device (10) according to any one of the devices described herein may be adapted for use as a billboard for outdoor use. Such billboards advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0227] Optionally, said picture display device (10) according to any one of the devices described herein may be adapted for use as a display for an in-flight entertainment system. Such in-flight entertainment systems advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0228] Optionally, said picture display device (10) according to any one of the devices described herein may be adapted for use as a display for an electronic or electro-mechanical slot-machine. Such slot-machines advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described

herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

[0229] Optionally, said picture display device (10) according to any one of the devices described herein may be adapted for use as a display of an electronic game. Such electronic games advantageously comprise an interface means for connecting to and controlling the cells of the device (10), optionally as described herein with reference to computer, television/video means or telephone means, *mutatis mutandis*.

Claims

1. A picture display device (10) comprising a suitable substrate (20) carrying a plurality of electro-luminescent cells (15) wherein each luminescent cell (15) is capable of emitting electromagnetic energy at least in the form of visible light, each said cell comprising:
 - luminescent means (17) **characterised in** enabling said cell (15) to emit electromagnetic energy at least in the form of visible light in correlation to the application of electrical current and/or voltage to the said cell (15);
 - suitable electrical connections electrically connectable to a suitable electrical power supply (99) and adapted to provide said cell with a suitable electrical current and/or voltage;
 - said suitable electrical connections comprise at least one pair of electrodes (22, 24) comprising a lower electrode (24) comprised on said substrate and an upper electrode (22) superimposed on and distanced from said lower electrode (24);
 - said at least one pair of electrodes (22, 24) capable of being electrically connected to at least one suitable electrical power source (99) capable of providing at least a predetermined voltage and/or current between said upper electrode and said lower electrode of said at least one pair of electrodes; and
 - said luminescent means (17) comprising at least one dielectric layer (19) comprised of suitable dielectric material disposed intermediate said upper electrode (22) and said lower electrode (24) of said at least one pair of electrodes;
 - wherein said dielectric layer (19) comprises a first luminescent layer (17A) of luminescent material substantially parallel to and in electrical contact with at least one of said upper electrode (24) and said lower electrode (22) of said at least one pair of electrodes, said first luminescent layer (17A) being capable of emitting electromagnetic energy at least in the form of visible light in response to the establishment of said predetermined voltage and/or current between said upper electrode (24) and said lower electrode (22) of said at least one pair of electrodes, wherein said emission of said visible light is such as to be capable of being observed from the exterior of said cell (15); and
 - wherein each said of least one pair of electrodes comprises at least a first pair of electrodes (23A) and a second said pair of electrodes (23B), and wherein said first luminescent layer (17A) intermediate said first pair of electrodes (23A) is such that the emission of said visible light by said cell (15) ceases in correlation with the magnitude of said voltage and/or current between said upper electrode (22A) and said lower electrode (24a) of said first pair of electrodes falling to substantially below a predetermined voltage and/or current threshold, and wherein a second said luminescent layer (17B) is disposed intermediate said second pair of electrodes (23B) is such that the emission of said visible light by said cell (15) endures for a substantial period of time after the magnitude of said voltage and/or current between said upper electrode (22B) and said lower electrode (24B) of said second pair of electrodes (23B) falls to substantially below the predetermined voltage and/or current threshold.
2. A picture display device as claimed in claim 1, wherein said first pair of electrodes (23A) and corresponding said first luminescent layer (17A) disposed therebetween is nested within said second pair of electrodes (23B) and corresponding said second luminescent layer (17B) disposed therebetween.
3. A picture display device as claimed in claim 2, wherein said first luminescent layer (17A) is substantially disc-shaped, and wherein said second luminescent layer (17B) is substantially annular-shaped.
4. A picture display device as claimed in claim 1, wherein said luminescent layer (17) intermediate said second pair of electrodes (23B) comprises a suitable phosphorescent material.
5. A picture display device as claimed in claim 1, wherein said luminescent layer (17) is such that the visible light emitted by said cell is of a wavelength corresponding to a predetermined one of the three primary colours.
6. A picture display device as claimed in claim 1, wherein said luminescent layer (17) is such that the visible light

emitted by said cell is substantially white light.

- 5 7. A picture display device as claimed in claim 6, wherein each said cell (15) further comprises a filter layer (16) comprising a suitable optical filter superposed over said upper electrode (22) of said at least one pair of electrodes, said optical filter (16) adapted to enable the visible light emitted by said cell (15) to be of a predetermined colour.
8. A picture display device as claimed in claim 7, wherein said predetermined colour is one of the primary colours.
- 10 9. A picture display device as claimed in claim 1, wherein said predetermined voltage is in the range of about 105 volts to about 110 volts.
10. A picture display device as claimed in claim 1, wherein said luminescent layer (17) comprises zinc sulphide activated with silver or copper.
- 15 11. A picture display device as claimed in claim 1, wherein said luminescent layer (17) comprises zinc silicate activated with manganese.
12. A picture display device according to claim 1, wherein said substrate (20) is flexible.
- 20 13. A picture display device according to claim 1, wherein said substrate (20) is substantially rigid.
14. A picture display device according to claim 1, wherein at least the corresponding electrically conducting elements (22, 24) of adjacent cells are electrically insulated one from another.
- 25 15. A picture display device according to claim 14, wherein said insulation is achieved by means of an insulating material placed at least between the said corresponding electrically conducting elements of adjacent cells.
- 30 16. A picture display device according to claim 14, wherein said insulation is achieved by means of a non-electrically-conductive space existing between at least the said corresponding electrically conducting elements of adjacent cells.
17. A picture display device according to claim 1, wherein the said plurality of cells (15) are arranged in the form of a substantially rectangular grid.
- 35 18. A picture display device according to claim 1, wherein the said cells (15) are substantially divided into a first, a second and a third group, the said second colour of the cells (15) in said first group being a colour of red, the said second of the cells (15) of said second group being a colour of blue, and the second colour of the cells (15) in said third group being a colour of green.
- 40 19. A picture display device according to claim 18, wherein the cells (15) comprising said three groups are substantially homogeneously distributed over the said substrate (20).
20. A picture display device according to claim 1, wherein the said cells are between 0.1mm and 1.0 meter in equivalent diameter.
- 45 21. A picture display device according to claim 1, wherein the said power source (99) comprises a suitable DC power supply including a suitable battery.
- 50 22. A picture display device according to claim 1, wherein the said power source (99) comprises a suitable photoelectric cell.
23. A picture display device according to claim 1, wherein the said power source (99) is comprised on said substrate.
- 55 24. A picture display device according to claim 23, wherein the said power source (99) is suitably printed onto said substrate.
25. A picture display device according to claim 1, wherein the said power source (99) comprises a suitable AC power supply optionally operatively connected to a suitable rectifier.

26. A picture display device according to claim 1, wherein the said power source (99) is electrically connected to at least a portion of said plurality of said cells (15) via a frame circuit board (70), said frame circuit board being characterised in providing suitable interconnections between said power source (99) and at least one of the said input and output connection means of each of the said cells (15) of the said portion of said cells (15).
27. A picture display device according to claim 26, wherein when said portion of cells (15) are chosen such that when the said cells (15) of said portion of said cells (15) are electrically connected to said power source a predetermined image comprised of each said second colour of each corresponding said cells (15) of said portion of cells (15) is exhibited by the said device.
28. A picture display device according to claim 26 further comprising sequencing means (60) wherein said sequencing means electrically connects the said power source selectively to each said frame circuit board (70).
29. A picture display device according to claim 28, wherein the said sequencing means (60) electrically connects said power source to each said frame circuit board (70) of said plurality of frame circuit boards in a predetermined sequence.
30. A picture display device according to claim 29, wherein the said sequencing means electrically connects said power source to each of successive frame circuit board of said plurality of frame circuit boards at a predetermined rate.
31. A picture display device according to claim 29, wherein the said predetermined rate may be between about 1 and about 30 frame circuit board connections per second, and preferably about 15 frame circuit board connections per second.
32. A picture display device according to claim 28, wherein each said frame circuit board (70) enables a predetermined image to be exhibited by the said device.
33. A picture display device according to claim 32, wherein the said sequencing means (60) sequentially connects said plurality of frame circuit boards to said power source to display on said picture display, a selection of predetermined images to thereby produce an illusion of movement of an image.
34. A picture display device according to claim 29, wherein the said sequencing means (60) electrically connects said power source (60) to each of said successive frame circuit board (70) of said plurality of frame circuit board on demand by means of a suitable switch.
35. A picture display device according to claim 34, wherein said switch is operable by a user of said device.
36. A picture display device according to claim 29 wherein said sequencing means (60) operates in consecutive cycles, whereby in each said cycle the said sequencing means electrically connects said power source (99) to each said frame circuit board (70) of said plurality of frame circuit boards in said predetermined sequence.
37. A picture display device according to claim 28, wherein said sequencing means (60) comprises a suitably programmed microprocessor chip.
38. A picture display device according to claim 28, wherein said sequencing means (60) comprises a first switch (610) for electrically connecting between at least one pair of electrical conductors, one conductor of said pair being electrically connectable to a suitable power source (99) and the other conductor of said pair being connectable to a corresponding frame circuit board (70), said first switch (610) comprising:-
 - a suitable substantially non-electrically-conducting fluid medium (621) in the form of a closed loop (611) and having a free upper surface;
 - said closed loop (611) bounded by at least an inner wall (633) and an outer wall (632), said inner and outer walls (632) being concentric one to the other and comprising an upper inner wall portion (613) and an inner wall portion (613), respectively, protruding from the mean level of the said fluid free surface;
 - at least one said pair of conductors (626, 627), one said conductor of said pair comprising a suitable first electrical contact (626) on said upper inner wall portion, and the other said conductor comprising a suitable second electrical contact (627) on said upper outer wall portion;

at least one electrically actuatable oscillating element (623) immersed in said fluid medium (621) capable of providing at least one travelling wave on said free surface in response to suitable vibrations thereof; an electrically-conductive dynamic contact element (625), substantially on said free surface and capable of being carried by said wave, said contact element (625) extending at least between said first electrical contact (626) and said second electrical contact (627);

whereby when said oscillating element (623) is suitably vibrated, at least one travelling wave is provided on said free surface carrying the said dynamic element (625) along said free surface element alternately to a position providing electrical contact between said first contact (627) and said second contact (626) and to a position in which said first contact and said second contact (627,626) are electrically disconnected.

39. A picture display device according to claim 38, wherein said oscillating element (623) is operatively connected to any suitable electrical power source (99).

40. A picture display device according to claim 38, wherein said first contact (626) and said second contact (627) of each said pair of conductors are substantially facing one another.

41. A picture display device according to claim 38, wherein said first switch (610) comprises a plurality of said pairs of conductors (626, 627).

42. A picture display device according to claim 41, wherein the said first contact of each of said plurality of said pairs of conductors (626, 627) are electrically interconnected.

43. A picture display device according to claim 42, wherein the said first contact of each of said plurality of said pairs of conductors (626, 627) are in the form of a suitable single electrical contact.

44. A picture display device according to claim 42, wherein said single electrical contact is in the form of a conducting band on said upper inner wall portion.

45. A picture display device according to claim 41, wherein the said second contact of each of said plurality of said pairs of conductors are electrically interconnected.

46. A picture display device according to claim 45, wherein the said second contact of each of said plurality of said pairs of conductors (626, 627) are in the form of a suitable single electrical contact.

47. A picture display device according to claim 45, wherein said single electrical contact is in the form of a conducting band on said upper outer wall portion.

48. A picture display device according to claim 38, wherein said dynamic contact element (625) is substantially spherical.

49. A picture display device according to claim 38, wherein said dynamic contact element (625) comprises a suitable liquid droplet.

50. A picture display device according to claim 49, wherein said liquid droplet comprises a water droplet.

51. A picture display device according to claim 38, wherein said fluid medium comprises a suitable liquid including oil.

52. A picture display device according to claim 38, wherein said closed loop (611) is substantially annular.

53. A picture display device according to claim 28, wherein said sequencing means (60) comprises a second switch (710) for electrically connecting between at least one pair of electrical conductors, one conductor of said pair being electrically connectable to a suitable power-source (99) and the other conductor of said pair being connectable to a corresponding frame circuit board, said second switch (710) comprising:-

an inner substantially non-electrically-conducting ring (735) and an outer concentric substantially non-electrically-conducting ring (725);

at least one said pair of conductors, one said conductor of said pair comprising a suitable first electrical contact

(730) on said inner ring (735), and the other said conductor comprising a suitable second electrical contact (720) on said outer ring (725);

an electrically-conductive dynamic contact element (770), substantially extending at least between said first electrical contact (730) and said second electrical contact (720);

a suitable motor (750) suitably operatively connected to at least one of said inner ring (735), said outer ring (725) and said contact element (770) such as to provide relative rotational motion between said contact element (770) and at least one of said inner ring (735) and said outer ring (725);

whereby when said motor (750) provides suitable relative rotational motion between said contact element (770) and at least one of said inner ring (735) and said outer ring (725), the said dynamic element (770) is brought alternately to a position providing electrical contact between said first contact (730) and said second contact (720) and to a position in which said first contact (730) and said second contact (720) are electrically disconnected.

54. A picture display device according to claim 53, wherein said motor (750) is a flat electrical motor operatively connectable to any suitable electrical power source (97).

55. A picture display device according to claim 53, wherein said first contact (730) and said second contact (720) of each said pair of conductors are substantially facing one another.

56. A picture display device according to claim 53, wherein said second switch (710) comprises a plurality of said pairs of conductors.

57. A picture display device according to claim 56, wherein the said first contact (730) of each of said plurality of said pairs of conductors are electrically interconnected.

58. A picture display device according to claim 57, wherein the said first contact (730) of each of said plurality of said pairs of conductors are in the form of a suitable single electrical contact.

59. A picture display device according to claim 57, wherein said single electrical contact is in the form of a conducting band on said inner ring.

60. A picture display device according to claim 57, wherein the said second contact (720) of each of said plurality of said pairs of conductors are electrically interconnected.

61. A picture display device according to claim 60, wherein the said second contact (720) of each of said plurality of said pairs of conductors are in the form of a suitable single electrical contact.

62. A picture display device according to claim 60, wherein said single electrical contact is in the form of a conducting band on said outer ring.

63. A picture display device according to claim 53, wherein said inner ring (735) and said outer ring (725) are substantially static, and said dynamic element (770) is suitably carried on a rotor arm (760) operatively connected to said motor (750) capable of rotating about the common axis of said inner ring (735) and said outer ring (725).

64. A picture display device according to claim 53, wherein said dynamic contact element (770) comprises a suitable electrical conductor.

65. A picture display device according to claim 28, wherein said sequencing means (60) comprises a third switch (810) for electrically connecting between a first electrical conductor and a plurality of electrical output conductors, said first electrical conductor being electrically connectable to a suitable power source and each said electrical output conductor being connectable to a corresponding frame circuit board, said third switch (810) comprising:-

a base (860);

a plurality of suitable bimetallic strips (850), each said bimetallic strip being suitably attached at a first end (871) thereof to said base (860), said bimetallic strips (850) being reversibly deformable from a first configuration to a second configuration in response to at least a predetermined change in temperature of said bimetallic strip (850), such that the second end (872) of each said bimetallic strip (850) is correspondingly displaced from a first position to a second position, respectively;

a first electrical conductor (820) electrically connected at least to each said first ends (871) of said bimetallic strips (850);

a second electrical conductor (82) spaced from said base (860), said second end (872) of each said bimetallic strip (850) being substantially free to reciprocate between said first position and said second position, respectively capable of establishing and breaking electrical contact between said bimetallic strip (850) and said second electrical conductor (82);

said first electrical conductor (820) and said second electrical conductor (82) being operatively connectable to a suitable electrical power source (99);

said bimetallic strips (850) being electrically heatable to at least said predetermined change in temperature when said second ends (872) thereof are in electrical contact with said second conductor (82);

a plurality of electrical output conductors (830), wherein each said output conductor (830) is suitably disposed with respect to said second end (872) of a corresponding said bimetallic strip (850) such that said output conductor (830) may be brought into common electrical contact with said corresponding bimetallic strip (850) and said second conductor (82) only when said corresponding bimetallic strip (850) is in electrical contact with said second conductor (82);

wherein the heating and/or cooling rates of at least one of the said plurality of bimetallic strips (850) may be different from the heating and/or cooling rates, respectively, of at least one other bimetallic strip (850), wherein said difference in heating and/or cooling rates enables at least one said output conductor (830) to be electrically connected to a corresponding bimetallic strip (850) and said second conductor (82) while at least another said output conductor (830) is concurrently electrically disconnected from its corresponding bimetallic strip (850) and said electrical conductor (82).

66. A picture display device according to claim 65, wherein said first electrical conductor (820) and said second electrical conductor (82) are electrically connected to a suitable electrical power source (99).

67. A picture display device according to claim 65, wherein said first electrical conductor (820) and said base (860) are integral.

68. A picture display device according to claim 65, wherein said first electrical conductor (820) and said second electrical conductor (82) are substantially parallel.

69. A picture display device according to claim 65, wherein at least one said electrical output (830) conductor is suitably attached to corresponding said bimetallic strip (850).

70. A picture display device according to claim 65, further comprising at least one common bimetallic strip (850) in series with said first electrical conductor (820) and/or said second electrical conductor (82).

71. A picture display device according to claim 70, wherein said at least common bimetallic strip (850) has a heating rate which is substantially slower than the heating rate of any one of said plurality of bimetallic strips (850).

72. A picture display device according to claim 70, wherein said at least common bimetallic strip (850) has a cooling rate which is substantially slower than the heating rate of any one of said plurality of bimetallic strips (850).

73. A picture display device according to claim 65, wherein said plurality of bimetallic strips (850) are substantially parallel one to another.

74. A picture display device according to claim 28, wherein said sequencing means (60) comprises a switch (910) for electrically connecting between a first electrical conductor and a plurality of electrical output conductors, said first electrical conductor being electrically connectable to a suitable power source and each said electrical output conductor being connectable to a corresponding frame circuit board, said fourth switch comprising:-

a base (960);

a plurality of suitable piezoelectric elements (950), each said piezoelectric element (950) being suitably attached at a first end (971) thereof to said base (960), each said piezoelectric element (950) being vibratory between a first amplitude and a second amplitude in response to the supply of a suitable electrical current and/or voltage to said piezoelectric element (950), such that the second end (972) of each said piezoelectric elements (950) is correspondingly displaced from a first position to a second position, respectively;

a first electrical conductor (920) electrically connected at least to each said first ends (971) of said piezoelectric elements (950);

a second electrical conductor (92) spaced from said base (960), said second end (972) of each said piezoelectric elements (950) being substantially free to reciprocate between said first position and said second position, respectively capable of establishing and breaking electrical contact between said piezoelectric elements (950) and said second electrical conductor (92);

said first electrical conductor (920) and said second electrical conductor (92) being operatively connectable to a suitable electrical power source (99);

said piezoelectric elements (950) being vibratory when said second ends thereof are in electrical contact with said second conductor (92);

a plurality of electrical output conductors (930), wherein each said output conductor (930) is suitably disposed with respect to said second end (972) of a corresponding said piezoelectric element (950) such that said output conductor (930) may be brought into common electrical contact with said corresponding piezoelectric element (950) and said second conductor only when said corresponding piezoelectric element (950) is in electrical contact with said second conductor (92);

wherein the phase of vibration of at least one of the said plurality of piezoelectric elements (950) may be different from the phase of vibration of at least one other piezoelectric element and, wherein said phase difference enables at least one said output conductor (930) to be electrically connected to a corresponding piezoelectric element (950) and said second conductor (92) while at least another said output conductor (930) is concurrently electrically disconnected from its corresponding piezoelectric element (950) and said electrical conductor.

75. A picture display device according to claim 74, wherein said first electrical conductor (920) and said second electrical conductor (92) are electrically connected to a suitable electrical power source (99).

76. A picture display device according to claim 74, wherein said first electrical conductor (920) and said base (960) are integral.

77. A picture display device according to claim 74, wherein said first electrical conductor (920) and said second electrical conductor (92) are substantially parallel.

78. A picture display device according to claim 74, wherein at least one said electrical output conductor (930) is suitably attached to corresponding said piezoelectric element (950).

79. A picture display device according to claim 74, wherein said plurality of piezoelectric elements (950) are substantially parallel one to another.

80. A picture display device according to claim 74, wherein said difference in phase of vibration between adjacent piezoelectric elements (950) is achieved by live-connecting the said power source to said first ends of said plurality of piezoelectric elements (950) at a predetermined rate.

81. A picture display device as claimed in claim 1 adapted for use as a display for an in-flight entertainment system.

82. A picture display device as claimed in claim 1 adapted for use as a display for an electronic or electro-mechanical slot-machine.

83. A picture display device as claimed in claim 1 adapted for use as a display of an electronic game.

84. A picture display device according to claim 1, wherein said device is attachable to an article of manufacture.

85. A picture display device according to claim 1, wherein said device is attachable to packaging means.

86. A picture display device according to claim 86, wherein said device is integral with said packaging means.

87. A picture display device according to claim 1, further comprising suitable interface means for using said device as a suitable display screen optionally for use with a computer, television/video means or telephone means.

88. A picture display device according to claim 26, wherein said frame circuit cards are suitably configured such as to

enable said device to display images corresponding to normally-printed matter including texts and pictures.

89. A picture display device according to claim 26, wherein said frame circuit cards are suitably configured such as to enable said device to display images corresponding to printed matter that includes any one or more of the following: book, newspaper, magazine, booklet, manual, greeting card, personal card, seasonal card, visiting card, advertisement card, postage and other stamp, postcard, sticker, label, poster, banner, flag, emblem, badge, prospectus, illustration guide, map, picture, and printed propaganda, among others.
90. A picture display device according to claim 26, further comprising suitable chronometer means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display images corresponding to the time and/or the date.
91. A picture display device according to claim 26, further comprising suitable meter means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display images corresponding to the magnitude of a variable quantified by said meter.
92. A picture display device according to claim 26, further comprising suitable chronometer means operatively connected thereto, wherein said frame circuit cards are suitably configured such as to enable said device to display different images according to the current to the time and/or the date.
93. Use of a picture display device according to claim 92, wherein said device is suitably configured as a traffic or road sign.
94. Use of a picture display device according to claim 26, wherein said device is adapted for use as a lottery ticket.
95. Use of a picture display device according to claim 26, wherein said device is adapted for use as a credit card.
96. Use of a picture display device according to claim 26, wherein said device is adapted for use as an identity card or identity document.
97. Use of a picture display device according to claim 26, wherein said device is adapted for use as a billboard for outdoor use.

Patentansprüche

1. Ein Bildanzeigegerät (10) mit einem geeigneten Farbträger (20), in denen sich eine Vielzahl von elektrolumineszierenden Zellen (15) befinden, in welchem jede einzelne Leuchtzelle (15) in der Lage ist, elektromagnetische Energie in zumindest der Form von sichtbarem Licht auszusenden und jede einzelne besagte Zelle aus folgendem besteht:

einem Leuchtstoff (17), der sich darin kennzeichnet, dass er der besagten Zelle (15) gestattet, elektromagnetische Energie, zumindest in der Form von sichtbarem Licht in Korrelation zur Anwendung von elektrischem Strom und/oder elektrischer Spannung auf die besagte Zelle (15) auszusenden;

geeignete elektrische Verbindungen, die an eine geeignete elektrische Stromversorgung (99) angeschlossen werden können und in der Lage sind, die besagte Zelle mit einem geeigneten elektrischen Strom und/oder einer angemessenen elektrischen Spannung zu versorgen;

die besagten elektrischen Verbindungen enthalten mindestens ein Elektrodenpaar (22,24) mit einer unteren Elektrode (24) bestehend aus dem sogenannten Farbträger und einer oberen Elektrode (22), die mit der besagten unteren Elektrode (24) überlagert und von ihr entfernt ist;

das mindestens ein Elektrodenpaar (22,24) muss an mindestens ein geeignetes elektrisches Stromnetz (99) angeschlossen werden können und in der Lage sein, mindestens eine vorbestimmte Spannung und/oder vorbestimmten Strom zwischen der besagten unteren Elektrode und der besagten oberen Elektrode des genannten mindestens einem Elektrodenpaar zu liefern; und der besagte Leuchtstoff (17) enthält mindestens eine dielektrische Schicht (19), bestehend aus einem geeigneten dielektrischen Material, das zwischen die besagte obere Elektrode (22) und die besagte untere Elektrode (24) des besagten mindestens einem Elektrodenpaar gesteckt wird;

in welchem die besagte dielektrische Schicht (19) eine erste Leuchtschicht (17A) mit Leuchtstoff enthält, das

- hauptsächlich parallel zu und in elektrischem Kontakt mit der ersten der besagten oberen Elektrode (22) und der besagten unteren Elektrode (24) der genannten mindestens einem Elektrodenpaar verläuft, in welchem die erste Leuchtschicht (17A) in der Lage sein muss, elektromagnetische Energie in mindestens der Form von sichtbarem Licht als Reaktion zur Erstellung der besagten vorbestimmten Spannung und/oder des vorbestimmten Stroms zwischen der sogenannten oberen Elektrode (22) und der sogenannten unteren Elektrode (24) des mindestens einem Elektrodenpaars auszusenden, in welchem diese Aussendung des sogenannten sichtbaren Lichts in der Lage sein muss, von außerhalb der besagten Zelle (15) gesehen werden zu können; und
- in welchem jede besagte Zelle mindestens ein Elektrodenpaar (23A) und ein zweites Elektrodenpaar (23B) enthält und in welchem die besagte erste Lichtschicht (17A) zwischen dem besagten ersten Elektrodenpaar (23A) die Aussendung des vorerwähnten sichtbaren Lichts durch die besagte Zelle (15) erlischt in Korrelation mit der Stärke der besagten Spannung und/oder des besagten Stroms zwischen der genannten oberen Elektrode (22A) und der genannten unteren Elektrode (24a) des besagten ersten Elektrodenpaars, die beträchtlich unter einen Grenzwert einer vorbestimmten Spannung und/oder eines vorbestimmten Stroms fällt und in welchem eine zweite sogenannte Schicht (17B) zwischen das besagte zweite Elektrodenpaar (23B) gesetzt wird, damit die Aussendung des sogenannten sichtbaren Lichts über die besagte Zelle (15) noch eine beträchtliche Zeit andauert, nachdem die Stärke der besagten Spannung und/oder des Stroms zwischen der besagten oberen Elektrode (22B) und der besagten unteren Elektrode (24B) des genannten zweiten Elektrodenpaars (23B) unter den Grenzwert der vorbestimmten Spannung und/oder des Stroms gefallen ist.
2. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem das besagte erste Elektrodenpaar (23A) und die entsprechende erste Lichtschicht (17A), die sich dazwischen befindet, innerhalb des besagten zweiten Elektrodenpaars (23B) und der entsprechenden besagten zweiten Lichtschicht (17B), die sich dazwischen befindet, eingesetzt ist.
 3. Ein Bildanzeigegerät, wie laut Anforderung 2 verlangt, in welchem die besagte Lichtschicht (17A) stark scheibenförmig ist und in welchem die besagte zweite Lichtschicht (17B) hauptsächlich ringförmig ist.
 4. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem die besagte Lichtschicht (17) zwischen dem zweiten Elektrodenpaar (23B) einen geeigneten phosphoreszierenden Stoff enthält.
 5. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem die besagte Lichtschicht (17) so konzipiert ist, dass das von der besagten Zelle ausgesandte sichtbare Licht eine Wellenlänge hat, die einer der vorbestimmten der drei Primärfarben entspricht.
 6. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem die besagte Lichtschicht (17) so konzipiert ist, dass das von der besagten Zelle ausgesandte sichtbare Licht im wesentlichen ein weißes Licht ist.
 7. Ein Bildanzeigegerät, wie laut Anforderung 6 verlangt, in welchem jede besagte Zelle (15) weiterhin eine Filterschicht (16) enthält, die aus einem geeigneten optischen Filter besteht, der die besagte obere Elektrode (22) des vorerwähnten mindestens einem Elektrodenpaars überlagert, in welchem der besagte optische Filter (16) in der Lage ist, das von der sogenannten Zelle (15) ausgesandte sichtbare Licht von einer bestimmten Farbe sein muss.
 8. Ein Bildanzeigegerät, wie laut Anforderung 7 verlangt, in welchem die besagte Farbe einer der Primärfarben ist.
 9. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem sich die vorbestimmte Spannung zwischen 105 Volt und 110 Volt befindet.
 10. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem die besagte Lichtschicht (17) mit Silber oder Kupfer aktiviertes Zinksulfit enthält.
 11. Ein Bildanzeigegerät, wie laut Anforderung 1 verlangt, in welchem die besagte Lichtschicht (17) mit Magnesium aktiviertes Zinksilikat enthält.
 12. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem der besagte Farbträger (20) flexibel ist.
 13. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem der besagte Farbträger (20) im wesentlichen starr ist.

14. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem mindestens die entsprechenden elektrisch leitenden Elemente (22, 24) der angrenzenden Zellen elektrisch voneinander isoliert sind.
- 5 15. Ein Bildanzeigegerät, gemäß Anforderung 14, in welchem die besagte Isolierung durch ein Isolationsmaterial erzielt wird, das zwischen die genannten elektrisch leitenden Elemente der angrenzenden Zellen gelegt wird.
16. Ein Bildanzeigegerät, gemäß Anforderung 14, in welchem die vorerwähnte Isolierung durch einen nicht elektrisch leitenden Abstand mindestens zwischen den besagten entsprechenden elektrisch leitenden Elementen der angrenzenden Zellen liegt.
- 10 17. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die sogenannte Mehrzahl an den Zellen (15) in Form eines im wesentlichen rechteckigen Gitters angeordnet sind.
18. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die sogenannten Zellen (15) im wesentlichen in eine erste, zweite und eine dritte Gruppe aufgeteilt sind, in welchem die besagte zweite Farbe der Zellen (15) in der vorerwähnten ersten Gruppe in einer roten Farbe, die vorerwähnte zweite der Zellen (15) der besagten zweiten Gruppe in einer blauen Farbe und die zweite Farbe der Zellen (15) in der vorerwähnten dritten Gruppe in einer grünen Farbe sind.
- 15 19. Ein Bildanzeigegerät, gemäß Anforderung 18, in welchem die Zellen (15), die aus den vorerwähnten drei Gruppen bestehen, im wesentlichen homogen über den sogenannten Farbträger (20) verteilt sind.
- 20 20. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die sogenannten Zellen aus einem äquivalenten Durchmesser zwischen 0,1 mm und 1,0 Meter bestehen.
- 25 21. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die besagte Stromversorgung (99) aus einer geeigneten Gleichstromzuführung einschließlich einer geeigneten Batterie besteht.
22. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die besagte Stromversorgung (99) eine geeignete Photozelle enthält.
- 30 23. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die besagte Stromversorgung (99) in dem sogenannten Farbträger enthalten ist.
- 35 24. Ein Bildanzeigegerät, gemäß Anforderung 23, in welchem die besagte Stromversorgung (99) in angemessener Form auf den sogenannten Farbträger gedruckt ist.
25. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die sogenannte Stromversorgung (99) eine geeignete Wechselstromversorgung enthält, die optional zum Betrieb an einen geeigneten Gleichrichter angeschlossen werden kann.
- 40 26. Ein Bildanzeigegerät, gemäß Anforderung 1, in welchem die sogenannte Stromversorgung (99) elektrisch mindestens an einen Teil der besagten Zellen (15) über eine gedruckte Bildschaltung (70) angeschlossen wird, in welchem sich die besagte gedruckte Bildschaltung durch die Bereitstellung einer geeigneten Zwischenverbindung zwischen der sogenannten Stromversorgung (99) und mindestens einer der besagten Eingangs- und Ausgangsanschlussmittel jeder einzelnen der besagten Zellen (15) des vorerwähnten Teils der besagten Zellen (15) kennzeichnet.
- 45 27. Ein Bildanzeigegerät, gemäß Anforderung 26, in welchem der besagte Teil der Zellen (15) so ausgewählt wird, dass, wenn die besagten Zellen (15) des vorerwähnten Teils (15) elektrisch an die sogenannte Stromversorgung angeschlossen werden, ein vorbestimmtes Bild bestehend aus der sogenannten zweiten Farbe jeder entsprechenden besagten Zelle (15) des vorerwähnten Teils (15) vom besagten Gerät angezeigt wird.
- 50 28. Ein Bildanzeigegerät, gemäß Anforderung 26, das weiterhin ein Sequenzierungsmittel (60) enthält, in welchem dieses Sequenzierungsmittel die sogenannte elektrische Stromversorgung selektiv mit jeder gedruckten Bildschaltung (70) verbindet.
- 55 29. Ein Bildanzeigegerät, gemäß Anforderung 28, in welchem das sogenannte Sequenzierungsmittel (60) die sogenannte

nannte Stromversorgung mit jeder vorerwähnten gedruckten Bildschaltung (70) der sogenannten Mehrzahl an den gedruckten Bildschaltungen in einer bestimmten Reihenfolge verbindet.

30. Ein Bildanzeigegerät, gemäß Anforderung 29, in welchem das sogenannte Sequenzierungsmittel die besagte Stromversorgung mit jeder einzelnen der aufeinanderfolgenden gedruckten Bildschaltungen der besagten Mehrzahl an gedruckten Bildschaltungen zu einem bestimmten Satz verbindet.
31. Ein Bildanzeigegerät, gemäß Anforderung 29, in welchem der sogenannte vorbestimmte Satz zwischen 1 und 30 Verbindungen gedruckter Bildschaltungen pro Sekunde und vorzugsweise um 15 Verbindungen gedruckter Bildschaltungen pro Sekunde liegen kann.
32. Ein Bildanzeigegerät gemäß Anforderung 28, in welchem jede besagte gedruckte Bildschaltung (70) in der Lage ist, ein vorbestimmtes Bild auf dem besagten Gerät anzuzeigen.
33. Ein Bildanzeigegerät gemäß Anforderung 32, in welchem jedes besagte Sequenzierungsmittel (60) die sogenannten vielzähligen gedruckten Bildschaltungen mit der besagten Stromversorgung an das Display des sogenannten Bildanzeigegerätes verbindet, in welcher eine Auswahl an vorbestimmten Bildern die Illusion der Bildbewegung herstellt.
34. Ein Bildanzeigegerät gemäß Anforderung 29, in welchem die besagten Sequenzierungsmittel (60) die sogenannte Stromversorgung (99) mit den vorerwähnten aufeinanderfolgenden gedruckten Bildschaltungen (70) der besagten vielzähligen gedruckten Bildschaltungen auf Anfrage über einen geeigneten Schalter verbindet.
35. Ein Bildanzeigegerät gemäß Anforderung 34, in welchem der besagte Schalter vom Benutzer des besagten Gerätes bedient wird.
36. Ein Bildanzeigegerät gemäß Anforderung 29, in welchem die besagten Sequenzierungsmittel (60) in aufeinanderfolgenden Zyklen arbeiten, in welchem in jedem sogenannten Zyklus die vorerwähnten Sequenzierungsmittel die vorerwähnte Stromversorgung (99) mit jeder besagten gedruckten Bildschaltung (70) der vielzähligen gedruckten Bildschaltungen in der vorbestimmten Folge.
37. Ein Bildanzeigegerät gemäß Anforderung 28, in welchem die besagten Sequenzierungsmittel (60) einen geeigneten programmierten Mikrochip enthalten.
38. Ein Bildanzeigegerät gemäß Anforderung 28, in welchem die besagten Sequenzierungsmittel (60) einen ersten Schalter (610) zur elektrischen Verbindung zwischen mindestens einem elektrischen Leiterpaar enthalten, in welchem ein Leiter dieses Paares elektrisch mit einer geeigneten Stromversorgung (99) anschließbar sein muss und der andere Leiter dieses Paares an eine entsprechende gedruckte Bildschaltung (70) anschließbar sein muss, in welchem der erste Schalter (610) folgendes enthält:

ein geeignetes, im wesentlichen nicht elektrisch leitendes flüssiges Mittel (621) in Form einer geschlossenen Schleife (611) und mit einer freien oberen Fläche:

die sogenannte geschlossene Schleife (611) die mindestens mit einer Innenwand (633) und einer Außenwand (632) verbunden ist und Außenwänden (632) die konzentrisch zueinander stehen und einem oberen Teil der Innenwand (613) und einem Teil der Innenwand (613), die entsprechend vom Pegel des Mittels der sogenannten Flüssigkeitsfreien Fläche herausragen.

mindestens eines der sogenannten Leiterpaare (626, 627), eines der sogenannte Leiter der vorerwähnten Paare muss einen geeigneten ersten elektrischen Leiter (626) auf der besagten oberen Innenwand enthalten und der andere besagte Leiter muss einen geeigneten zweiten elektrischen Kontakt (627) auf der besagten oberen Wand enthalten;

mindestens ein elektrisch aktivierbares oszillierendes Element (623), das in das besagte flüssige Mittel (621) eingelassen ist, muss in der Lage sein, mindestens eine fortschreitende Welle auf der besagten freien Fläche als Reaktion zu daraus entstehenden Vibrationen zu erzeugen.

ein elektrisch leitendes dynamisches Kontaktelement (625), das im wesentlichen auf der besagten freien Fläche von der besagten Welle getragen wird, in welchem sich das besagte Kontaktelement (625) mindestens zwischen dem besagten elektrischen Kontakt (626) und dem besagten zweiten elektrischen Kontakt (627) ausdehnt.

in welchem, wenn das sogenannte oszillierende Element (623) angemessen vibriert wird mindestens eine fortschreitende Welle auf der besagten freien Fläche erzeugt wird, die das sogenannte dynamische Element (625) über das sogenannte freie Flächenelement abwechselnd in einer Position bringt, die einen elektrischen Kontakt zwischen dem ersten Kontakt (627) und dem sogenannten zweiten Kontakt (626) elektrisch voneinander abgeklemmt werden.

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39. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem das sogenannte oszillierende Element (623) wirksam mit einer geeigneten elektrischen Stromversorgung (99) verbunden wird.
- 10 40. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem sich der besagte erste Kontakt (626) und der besagte zweite Kontakt (627) jedes besagten Leiterpaares im wesentlichen gegenüber stehen.
41. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem der erste Schalter (610) eine Vielzahl der besagten Leiterpaare enthält (626, 627).
- 15 42. Ein Bildanzeigegerät, gemäß Anforderung 41, in welchem der besagte erste Kontakt jeder besagten vielzähligen Leiterpaaren (626, 627) elektrisch miteinander verbunden sind.
43. Ein Bildanzeigegerät, gemäß Anforderung 42, in welchem der sogenannte erste Kontakt der sogenannten Vielzahl der besagten Leiterpaare (626, 627) in Form eines geeigneten elektrischen Einzelkontakts bestehen.
- 20 44. Ein Bildanzeigegerät, gemäß Anforderung 42, in welchem der sogenannte elektrische Einzelkontakt in Form eines leitenden Bandes auf dem Teil der oberen Innenwand besteht.
45. Ein Bildanzeigegerät, gemäß Anforderung 41, in welchem der sogenannte zweite Kontakt jedes der besagten vielzähligen Leiterpaare elektrisch miteinander verbunden sind.
46. Ein Bildanzeigegerät, gemäß Anforderung 45, in welchem der besagte zweite Kontakt jedes der vorerwähnten vielzähligen Leiterpaare (626, 627) in Form eines geeigneten elektrischen Einzelkontakts bestehen.
- 30 47. Ein Bildanzeigegerät, gemäß Anforderung 45, in welchem der besagte elektrische Einzelkontakt in Form eines leitenden Bandes auf dem besagten Teil der oberen Außenwand besteht.
48. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem das besagte dynamische Kontaktelement (625) im wesentlichen sphärisch ist.
- 35 49. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem das besagte dynamische Kontaktelement (625) ein kleines geeignetes flüssiges Tröpfchen enthält.
- 40 50. Ein Bildanzeigegerät, gemäß Anforderung 49, in welchem das sogenannte flüssige Tröpfchen aus einem Wassertropfen besteht.
51. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem das besagte flüssige Mittel eine geeignete Flüssigkeit, einschließlich Öl enthält.
- 45 52. Ein Bildanzeigegerät, gemäß Anforderung 38, in welchem die geschlossene Schleife (611) im wesentlichen ringförmig ist.
- 50 53. Ein Bildanzeigegerät, gemäß Anforderung 28, in welchem die besagten Sequenzierungsmittel (60) einen zweiten Schalter (710) zur elektrischen Verbindung zwischen mindestens einem elektrischen Leiterpaar beinhalten, wobei ein Leiter des besagten Paares elektrisch an eine geeignete Stromversorgung (99) anschließbar und der andere Leiter des besagten Paares an eine entsprechende gedruckte Bildschaltung anschließbar sein muss, wobei der zweite Schalter (710) folgendes beinhalten muss:

einen inneren, im wesentlichen nicht elektrisch leitenden Ring (735) und einen äußeren, konzentrischen, im wesentlichen nicht elektrisch leitenden Ring (735);
mindestens eines der besagten Leiterpaare, wobei einer der Leiter dieses Paares mit einem ersten elektrischen Kontakt (730) auf dem besagten Innenring (735) ausgestattet sein muss und der andere besagte Leiter
- 55

einen geeigneten elektrischen Kontakt (720) auf dem besagten Außenring (725) beinhalten muss;
 ein elektrisch leitendes dynamisches Kontaktelement (770), das sich im wesentlichen mindestens zwischen
 dem ersten elektrischen Kontakt (730) und dem besagten zweiten elektrischen Kontakt (720) ausdehnt;
 einen geeigneten Motor (750), der wirksam an mindestens einen der besagten Innenringe (735), den besagten
 Außenring (725) und dem besagten Kontaktelement (770) so angeschlossen ist, dass er eine relative Dreh-
 bewegung zwischen dem besagten Kontaktelement (770) und mindestens einem der besagten Innenringe
 (735) und dem besagten Außenring herstellen kann;

wobei der besagte Motor (750) eine angemessene relative Drehbewegung zwischen dem besagten Kontak-
 telement (770) und mindestens einem der besagten Innenringe (735) und dem besagten Außenring (725) erzeugt
 und das besagte dynamische Element (770) abwechselnd in eine Position gebracht wird, in der ein elektrischer
 Kontakt zwischen dem besagten ersten Kontakt (730) und dem besagten zweiten Kontakt (720) erzeugen kann
 und in eine Position gebracht wird, in der besagter erster Kontakt (730) und besagter zweiter Kontakt (720) elek-
 trisch voneinander abgeklemt sind.

54. Ein Bildanzeigegerät, gemäß Anforderung 53, in welchem der besagte Motor (750) ein flacher Elektromotor ist,
 der wirksam an irgendeine geeignete elektrische Stromversorgung (97) angeschlossen werden kann.

55. Ein Bildanzeigegerät, gemäß Anforderung 53, in welchem sich der besagte erste Kontakt (730) und der besagte
 zweite Kontakt (720) jedes besagten Leiterpaares im wesentlichen gegenüber stehen.

56. Ein Bildanzeigegerät, gemäß Anforderung 53, in welchem der besagte zweite Schalter (710) eine Vielzahl der
 besagten Leiterpaare enthält.

57. Ein Bildanzeigegerät, gemäß Anforderung 56, in welchem der besagte erste Kontakt (730) jedes einzelnen der
 vielzähligen Leiterpaare elektrisch miteinander verbunden sind.

58. Ein Bildanzeigegerät, gemäß Anforderung 57, in welchem der besagte erste Kontakt (730) jedes einzelnen be-
 sagten vielzähligen Leiterpaare in Form eines geeigneten elektrischen Einzelkontakts bestehen.

59. Ein Bildanzeigegerät, gemäß Anforderung 57, in welchem der besagte elektrische Einzelkontakt in Form eines
 leitenden Bandes auf dem besagten Innenring besteht.

60. Ein Bildanzeigegerät, gemäß Anforderung 57, in welchem der besagte zweite Kontakt (720) jedes einzelnen der
 vielzähligen Leiterpaare elektrisch miteinander verbunden sind.

61. Ein Bildanzeigegerät, gemäß Anforderung 60, in welchem der besagte zweite Kontakt (720) jedes einzelnen der
 vielzähligen Leiterpaare in Form eines geeigneten elektrischen Einzelkontakts besteht.

62. Ein Bildanzeigegerät, gemäß Anforderung 60, in welchem der besagte elektrische Einzelkontakt in Form eines
 leitenden Bandes auf dem besagten Außenring besteht.

63. Ein Bildanzeigesystem gemäß Anforderung 53, in welchem der besagte Innenring (735) und der besagte Außen-
 ring (725) im wesentlichen statisch sind und das besagte dynamische Element (770) angemessen auf einem Ro-
 torarm (760) transportiert und wirksam auf dem besagten Motor (750) angeschlossen ist, der in der Lage sein
 muss, sich über die gemeinsame Achse des vorerwähnten Innenrings (735) und den Außenring (725) zu bewegen.

64. Ein Bildanzeigesystem gemäß Anforderung 53, in welchem das dynamische Kontaktelement (770) einen passen-
 den elektrischen Leiter enthält.

65. Ein Bildanzeigesystem gemäß Anforderung 28, in welchem das Sequenzierungsmittel (60) einen dritten Schalter
 (810) zur elektrischen Verbinden zwischen einem ersten elektrischen Leiter und einer Vielzahl an elektrischen
 Leistungleitern enthält, wobei der erste elektrische Leiter elektrisch an eine geeignete Stromversorgung
 anschließbar sein muss und der besagte elektrische Ausgangsleiter an eine entsprechende gedruckte Bildschal-
 tung anschließbar sein muss, wobei der dritte Schalter (810) folgendes enthalten muss:

einen Sockel (860)

eine Vielzahl an passenden Bimetallstreifen (850), wobei jeder besagte Bimetallstreifen angemessen an ein

erstes Ende (872) des sogenannten Sockels (860) befestigt werden muss, wobei die Bimetallstreifen (850) beidseitig von einer ersten Konfiguration in eine zweite Konfiguration als Reaktion auf mindestens einer vorbestimmten Temperaturänderung des besagten Bimetallstreifens (850) verformbar sein müssen, damit das zweite Ende (872) jedes besagten Bimetallstreifens (850) entsprechend von einer ersten in eine zweite Position verlagert werden kann und umgekehrt;
 einen ersten elektrischen Leiter (820), der elektrisch an mindestens eines der besagten ersten Enden (871) der besagten Bimetallstreifen (850) angeschlossen ist;
 einen zweiten elektrischen Leiter (82) mit Abstand von dem besagten Sockel (860), wobei das zweite Ende (872) des besagten Bimetallstreifens (850) im wesentlichen frei zur Hin- und Herbewegung von der besagten ersten Position und der besagten zweiten Position sein und entsprechend in der Lage sein muss, einen elektrischen Kontakt zwischen dem vorerwähnten Bimetallstreifen (850) und dem besagten zweiten elektrischen Leiter (82) zu erzeugen und zu unterbrechen;
 der besagte erste elektrische Leiter (820) und der besagte zweite elektrische Leiter (82) müssen wirksam miteinander an eine geeignete elektrische Stromversorgung (99) anschließbar sein;
 die vorerwähnten Bimetallstreifen (850) müssen elektrisch bis auf mindestens die besagte vorbestimmte Temperaturänderung erheizbar sein, wobei die besagten zweiten Enden (872) davon elektrischen Kontakt mit dem zweiten Leiter (82) haben;
 eine Vielzahl an elektrischen Ausgangsleitern (830), in welchen jeder besagte Ausgangsleiter (830) angemessen in bezug auf das zweite Ende (872) eines entsprechenden besagten Bimetallstreifens (850) angeordnet ist, so dass der besagte Ausgangsleiter (830) nur dann in gemeinsamen elektrischen Kontakt mit den entsprechenden Bimetallstreifen (850) und dem besagten zweiten Leiter (82) gebracht werden kann, wenn der entsprechende Bimetallstreifen (850) elektrischen Kontakt mit dem zweiten Leiter (82) hat;

wobei die Heiz- und/oder Kühlleistungen mindestens einer der vielzähligen Bimetallstreifen (850) von den Heiz- und/oder Kühlleistungen von mindestens einem der anderen Bimetallstreifen (850) sein kann und umgekehrt, wobei der besagte Unterschied der Heiz- und/oder Kühlleistungen mindestens einem der besagten Ausgangsleiter (830) die elektrische Verbindung zu einem entsprechenden Bimetallstreifen (850) und einem zweiten Leiter (82) ermöglicht, während mindestens ein anderer vorerwählter Leiter ((830) gleichzeitig elektrisch von seinem entsprechenden Bimetallstreifen (850) und dem besagten elektrischen Leiter (82) abgekllemmt ist.

66. Ein Bildanzeigesystem gemäß Anforderung 65, in welchem der erste besagte elektrische Leiter (820) und besagter zweiter elektrischer Leiter (82) elektrisch an eine geeignete elektrische Stromversorgung (99) angeschlossen sind.
67. Ein Bildanzeigesystem gemäß Anforderung 65, in welchem der erste elektrische Leiter (820) und der sogenannte Sockel (860) integral sind.
68. Ein Bildanzeigesystem gemäß Anforderung 65, in welchem der besagten erste elektrische Leiter (830) und der besagte zweite elektrische Leiter (82) im wesentlichen parallel sind.
69. Ein Bildanzeigesystem gemäß Anforderung 65, in welchem mindestens einer der besagten elektrischen Ausgangsleiter (830) angemessen an einen entsprechenden Bimetallstreifen (850) befestigt ist.
70. Ein Bildanzeigesystem gemäß Anforderung 65, das weiterhin mindestens einen gemeinsamen mit dem besagten ersten elektrischen Leiter (820) und/oder dem zweiten elektrischen Leiter (82) in Reihe geschalteten Bimetallstreifen (850) enthält.
71. Ein Bildanzeigesystem gemäß Anforderung 70, in welchem mindestens der besagte gemeinsame Bimetallstreifen (850) eine Heizleistung hat, die im wesentlichen langsamer ist, als die Heizleistung irgendeines der vielzähligen Bimetallstreifen (850) ist.
72. Ein Bildanzeigesystem gemäß Anforderung 70, in welchem mindestens der besagte gemeinsame Bimetallstreifen (850) eine Kühlleistung hat, die im wesentlichen langsamer ist, als die Heizleistung irgendeines der vielzähligen Bimetallstreifen (850) ist.
73. Ein Bildanzeigesystem gemäß Anforderung 65, in welchem die vielzähligen Bimetallstreifen (850) im wesentlichen parallel zueinander sind.
74. Ein Bildanzeigesystem gemäß Anforderung 28, in welchem die besagten Sequenzierungsmittel (60) einen Schalter

(910) zur elektrischen Verbindung zwischen einem ersten elektrischen Leiter und einer Vielzahl an elektrischen Ausgangsleitern enthalten, wobei der erste elektrische Leiter elektrisch an eine geeignete Stromversorgung anschließbar sein muss und jeder besagte elektrische Ausgangsleiter an eine entsprechende gedruckte Bildschaltung anschließbar sein muss, wobei der vierte Schalter folgendes enthalten muss:

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einen Sockel (960),
eine Vielzahl geeigneter piezoelektrischer Elemente (950), wobei jedes piezoelektrische Element (950) angemessen an ein erstes Ende (971) des besagten Sockels (960) befestigt werden muss, da jedes piezoelektrische Element (950) Vibrationen zwischen der ersten Amplitude und der zweiten Amplitude als Reaktion auf die Versorgung durch einen geeigneten elektrischen Strom und/oder einer geeigneten Spannung erzeugt, so dass das zweite Ende (972) jedes besagten piezoelektrischen Elements (950) entsprechend von einer ersten in eine zweite Position und umgekehrt gebracht wird;
einen ersten elektrischen Leiter (920), der elektrisch mit mindestens jedem der ersten Enden (971) der besagten piezoelektrischen Elemente (950) verbunden ist;
einem zweiten elektrischen Leiter (92) mit Abstand vom besagten Sockel (960, wobei sich das zweite Ende jedes besagten piezoelektrischen Elements (950) im wesentlichen frei zwischen der ersten und der zweiten Position und umgekehrt hin- und herbewegen kann und in der Lage ist, einen elektrischen Kontakt zwischen den besagten piezoelektrischen Elementen (950 und dem zweiten elektrischen Leiter (92) herzustellen und zu unterbrechen.
der erste elektrische Leiter (920) und der besagte zweite elektrische Leiter (92) müssen wirksam an eine geeignete elektrische Stromversorgung (99) anschließbar sein;
die besagten piezoelektrischen Elemente (950) vibrieren, während deren zweiten Enden elektrischen Kontakt mit dem besagten zweiten Leiter (92) haben;
eine Vielzahl elektrischer Ausgangsleiter (930), in welchen jeder besagte Ausgangsleiter (930) angemessen in bezug auf das besagte zweite Ende (972) eines entsprechenden piezoelektrischen Elements (950) angeordnet ist, so dass besagter Ausgangsleiter (930) nur dann mit dem entsprechenden piezoelektrischen Element (950) und dem besagten zweiten Leiter gebracht in gemeinsamen elektrischen Kontakt gebracht werden kann, wenn besagtes entsprechendes piezoelektrisches Element (950) elektrischen Kontakt mit dem zweiten Leiter (92) hat;
in welchem die Vibrationsphase von mindestens einem der besagten vielzähligen piezoelektrischen Elemente (950) von der Vibrationsphase von mindestens einem der anderen piezoelektrischen Elemente differieren kann, wobei die besagte Differenzphase mindestens eines der besagten Ausgangsleiter (930) gestattet, elektrisch an ein entsprechendes piezoelektrisches Element (950) und besagten zweiten Leiter (92) angeschlossen werden kann, während mindestens ein anderer der besagten Ausgangsleiter (930) gleichzeitig elektrisch von seinem entsprechenden piezoelektrischen Element (950) und dem besagten elektrischen Leiter abgeklemmt werden kann.

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75. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem der erste elektrische Leiter (920) und der besagte zweite elektrische Leiter (92) elektrisch miteinander an eine geeignete elektrische Stromversorgung (99) verbunden sind.

76. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem der erste elektrische Leiter (920) und der besagte Sockel (960) integral sind.

77. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem der erste besagte elektrische Leiter (920) und der zweite besagte elektrische Leiter (92) im wesentlichen parallel sind.

78. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem mindestens der erste elektrische Ausgangsleiter (930) angemessen an das entsprechende piezoelektrische Element (950) angeschlossen sind.

79. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem die besagte Vielzahl piezoelektrischer Elemente (950) im wesentlichen parallel zueinander liegen.

80. Ein Bildanzeigesystem gemäß Anforderung 74, in welchem die besagte Differenz der Vibrationsphase zwischen den angrenzenden piezoelektrischen Elementen (950) durch eine stromführende Verbindung der besagten Stromversorgung an die besagten ersten Enden der vielzähligen piezoelektrischen Elemente (950) zu einer bestimmten Nennleistung.

81. Ein Bildanzeigesystem wie laut Anforderung 1 verlangt, das sich zur Benutzung als Display für ein elektronisches Flugspelesystem eignet.
82. Ein Bildanzeigesystem gemäß Anforderung 1 verlangt, das sich zur Benutzung als Display für eine elektronischen oder elektromechanischen Automaten eignet.
83. Ein Bildanzeigesystem wie laut Anforderung 1 verlangt, das sich zur Benutzung als Display für ein elektronisches Spiel eignet.
84. Ein Bildanzeigesystem, gemäß Anforderung 1, welches an einen fertiggestellten Artikel befestigt werden kann.
85. Ein Bildanzeigesystem, gemäß Anforderung 1, welches an die Verpackungsmittel befestigt werden kann.
86. Ein Bildanzeigesystem gemäß Anforderung 86, welches integral mit den Verpackungsmitteln ist.
87. Ein Bildanzeigesystem, gemäß Anforderung 1, das weiterhin für Schnittstellen enthalten muss, um dieses Gerät optional als angemessenen Display mit einem Computer, Fernseher/Videogerät oder Telefon benutzen zu können.
88. Ein Bildanzeigesystem, gemäß Anforderung 26, in welchem die sogenannten gedruckten Bildschaltungen so konfiguriert sind, dass das Gerät in der Lage ist, Bilder entsprechend eines normal gedruckten Dokuments, einschließlich Text und Bildern anzuzeigen.
89. Ein Bildanzeigesystem, gemäß Anforderung 26, in welchem die sogenannten gedruckten Bildschaltungen so konfiguriert sind, dass das Gerät in der Lage ist, Bilder entsprechend eines normal gedruckten Dokuments, mit irgendeinem oder mehr der folgenden anzuzeigen: Buch, Zeitung, Zeitschrift, Broschüre, Handbuch, Grußkarte, Visitenkarte, Glückwunschkarte, Besucherkarte, Werbekarte, Briefmarke oder andere Frankierungen, Aufkleber, Etiketten, Poster, Banner, Flagge, Emblem, Namensschild, Prospekt, bebildeter Führer, Karte, Bild und gedruckte Propaganda, etc.
90. Ein Bildanzeigesystem, gemäß Anforderung 26, das weiterhin einen geeigneten Chronometer enthält, der wirksam angeschlossen ist, wobei die sogenannten gedruckten Bildschaltungen so konfiguriert sein müssen, dass das Gerät Bilder im Verhältnis zur Uhrzeit und/oder Datum anzeigen kann.
91. Ein Bildanzeigesystem, gemäß Anforderung 26, das weiterhin ein geeignetes Messgerät enthält, das wirksam angeschlossen ist, wobei die sogenannten gedruckten Bildschaltungen so konfiguriert sind, dass das Gerät in der Lage ist, entsprechend der Größe einer variablen Menge durch das besagte Messgerät anzuzeigen.
92. Ein Bildanzeigesystem, gemäß Anforderung 26, das weiterhin einen geeigneten Chronometer enthalten muss, der wirksam angeschlossen ist, wobei die sogenannten gedruckten Bildschaltungen so konfiguriert sind, dass das Gerät in der Lage ist verschiedene Bilder je nach der aktuellen Uhrzeit und/dem Datum anzuzeigen.
93. Die Benutzung eines Bildanzeigesystems gemäß Anforderung 92, wobei das besagte Gerät so konfiguriert ist, dass es sich als Verkehrs- oder Straßenzeichen eignet.
94. Die Benutzung eines Bildanzeigesystems gemäß Anforderung 26, wobei das besagte Gerät so angepasst ist, dass es als Lotterielos verwendet werden kann.
95. Die Benutzung eines Bildanzeigesystems gemäß Anforderung 26, wobei das besagte Gerät so angepasst ist, dass es als Kreditkarte verwendet werden kann.
96. Die Benutzung eines Bildanzeigesystems gemäß Anforderung 26, wobei das besagte Gerät so angepasst ist, dass es als Personalausweis oder Reisepass verwendet werden kann.
97. Die Benutzung eines Bildanzeigesystems gemäß Anforderung 26, wobei das besagte Gerät als Anschlagfläche im Freien verwendet werden kann.

Revendications

1. Un dispositif de visualisation d'image (10) comprenant un support approprié (20) portant une multitude de cellules électroluminescentes (15) où chaque cellule lumineuse (15) a la capacité d'émettre une énergie électromagnétique, tout du moins sous la forme de lumière visible, chaque cellule en question étant composée :

de moyens lumineux (17) caractérisés par le fait qu'ils permettent à chaque cellule (15) en question d'émettre une énergie électromagnétique, tout du moins sous la forme de lumière visible liée à l'application d'un courant et/ ou d'une tension électrique sur ladite cellule (15) ;

des raccordements électriques appropriés qui peuvent être branchés au bloc d'alimentation électrique adéquat (99) et adaptés de sorte à fournir à cette cellule le courant et/ ou la tension électrique approprié ;

ces branchements électriques appropriés sont composés au minimum d'une paire d'électrodes (22, 24) comprenant une électrode inférieure (24) disposée sur le support en question et une électrode supérieure (22) superposée à quelque distance de l'électrode inférieure (24) ;

cette même paire d'électrodes (22, 24) qui peut être branchée au moins à une source d'alimentation électrique (99) capable de fournir au moins une tension et/ ou un courant prédéfini entre l'électrode supérieure et l'électrode inférieure qui composent au moins une paire d'électrodes ; et

ces moyens lumineux (17) comprenant au moins une couche diélectrique (19) composée de matériel diélectrique approprié disposé entre l'électrode supérieure (22) et l'électrode inférieure (24) qui composent au moins une paire d'électrodes ;

où cette couche diélectrique (19) est composée d'une première couche lumineuse (17A) de matériel lumineux parfaitement parallèle et en contact électrique avec au moins l'électrode supérieure (24) et l'électrode inférieure (22) qui composent au moins une paire d'électrodes, cette première couche lumineuse (17A) étant capable d'émettre une énergie électromagnétique, tout du moins sous la forme d'une lumière visible, en réponse à l'établissement de la tension et/ ou du courant prédéfini qui circule entre l'électrode supérieure (24) et l'électrode inférieure (22) qui composent au moins une paire d'électrodes, où l'émission de cette lumière visible est telle qu'elle peut être observée de l'extérieur de cette cellule (15) ;

où cette même paire d'électrodes (23A) ainsi qu'une deuxième paire d'électrodes (23B) et où la première couche lumineuse (17) en question, qui s'intercale entre la première paire d'électrodes (23A), sont telles que l'émission de cette lumière visible causée par cette cellule (15) cesse en fonction de l'intensité de la tension et/ ou du courant qui circule entre l'électrode supérieure (22A) et l'électrode inférieure (24a) qui composent ladite première paire d'électrodes en chutant très en dessous d'un seuil de tension et/ ou de courant prédéfini et où la deuxième couche lumineuse (17B) qui est placée entre la deuxième paire d'électrodes (23B) est telle que l'émission de cette lumière visible causée par cette cellule (15) se maintient pendant une durée considérable après que l'intensité de cette tension et/ ou de ce courant qui circule entre l'électrode supérieure (22B) et l'électrode inférieure (24B) qui composent ladite deuxième paire d'électrodes (23B) a chuté très en dessous du seuil de tension et/ ou du courant prédéfini.
2. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où la première paire d'électrodes (23A) et la première couche lumineuse correspondante (17A) disposée entre elles, s'emboîtent dans la deuxième paire d'électrodes (23B) et dans la deuxième couche lumineuse correspondante (17B) disposée entre elles.
3. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 2, où la première couche lumineuse (17A) a en grande partie la forme d'un disque et où la deuxième couche lumineuse (17B) a en grande partie la forme d'un anneau.
4. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où ladite couche lumineuse (17) qui s'intercale entre la deuxième paire d'électrodes (23B), se compose d'un matériel phosphorescent approprié.
5. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où ladite couche lumineuse (17) est telle que la lumière visible émise par la cellule en question dispose d'une longueur d'onde correspondant à l'une des trois couleurs primaires prédéfinies.
6. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où ladite couche lumineuse (17) est telle que la lumière visible émise par la cellule en question est particulièrement blanche.
7. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 6, où chaque cellule compte en

outre une couche filtrante (16) composée d'un filtre optique approprié superposé sur l'électrode supérieure (22) qui compose au moins une paire d'électrodes, le filtre optique (16) en question étant adapté de sorte à permettre à la lumière visible émise par la cellule en question (15) d'être d'une couleur prédéfinie.

- 5 8. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 7, où la couleur prédéfinie est sélectionnée parmi les couleurs primaires.
9. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où la tension prédéfinie équivaut à une gamme comprise entre 105 et 110 volts.
- 10 10. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où cette couche luminescente (17) est composée de silicate de zinc activé avec de l'argent ou du cuivre.
11. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où ladite couche luminescente 15 (17) est composée de silicate de zinc activé avec du manganèse.
12. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ledit support (20) est flexible.
13. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ledit support (20) est substantielle- 20 ment rigide.
14. Un dispositif de visualisation d'image, correspondant à la revendication 1, où au moins les éléments conducteurs d'électricité correspondants (22, 24) des cellules adjacentes sont isolés électriquement les uns des autres.
- 25 15. Un dispositif de visualisation d'image, correspondant à la revendication 14, où l'isolation en question est obtenue grâce à un matériau isolant placé au moins entre les éléments conducteurs d'électricité correspondants des cellules adjacentes.
16. Un dispositif de visualisation d'image, correspondant à la revendication 14, où l'isolation en question est obtenue 30 grâce à un espace non conducteur d'électricité qui existe au moins entre les éléments conducteurs d'électricité correspondants des cellules adjacentes.
17. Un dispositif de visualisation d'image, correspondant à la revendication 1, où les multiples cellules en question 35 (15) sont disposées sous forme d'une grille en grande partie rectangulaire.
18. Un dispositif de visualisation d'image, correspondant à la revendication 1, où les cellules en question (15) sont réellement réparties en un premier, un deuxième et un troisième groupe, la deuxième couleur des cellules (15) 40 qui se trouvent dans le premier groupe étant le rouge, la deuxième couleur des cellules (15) qui se trouvent dans le deuxième groupe étant le bleu et la deuxième couleur des cellules (15) qui se trouvent dans le troisième groupe étant le vert.
19. Un dispositif de visualisation d'image, correspondant à la revendication 18, où les cellules (15) comprenant les trois groupes évoqués, sont en grande partie réparties de manière homogène sur le support (20).
- 45 20. Un dispositif de visualisation d'image, correspondant à la revendication 1, où les cellules en question mesurent entre 0,1 mm et 1,0 mm de diamètre.
21. Un dispositif de visualisation d'image, correspondant à la revendication 1, où la source d'alimentation en question 50 (99) est composée d'un bloc d'alimentation en courant continu approprié qui inclut une batterie appropriée.
22. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ladite source d'alimentation (99) est composée d'une cellule photoélectrique appropriée.
23. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ladite source d'alimentation (99) est 55 comprise sur le support.
24. Un dispositif de visualisation d'image, correspondant à la revendication 23, où ladite source d'alimentation (99) est correctement imprimée sur ledit support.

25. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ladite source d'alimentation (99) inclut un bloc d'alimentation en courant alternatif approprié, qui peut facultativement être connecté de manière active à un redresseur approprié.
- 5 26. Un dispositif de visualisation d'image, correspondant à la revendication 1, où ladite source d'alimentation (99) est raccordée électriquement au moins à une partie de la multitude des cellules (15) par le biais d'un circuit imprimé à bâti (70), ledit circuit imprimé à bâti étant **caractérisé par le fait qu'il procure les interconnexions appropriées** entre la source d'alimentation (99) et au moins un des moyens de connexion d'entrée et de sortie de chacune des cellules (15) appartenant à la partie des cellules (15) en question.
- 10 27. Un dispositif de visualisation d'image, correspondant à la revendication 26, où lorsque ladite partie des cellules (15) est choisie de sorte que les cellules (15) appartenant à cette partie de cellules (15) soient branchées à la source d'alimentation en question, une image prédéfinie, composée de chaque deuxième couleur de chaque cellule (15) correspondante, appartenant à cette partie de cellules (15), est exposée par le dispositif en question.
- 15 28. Un dispositif de visualisation d'image, correspondant à la revendication 26 comprenant en outre des moyens de séquençement (60), où lesdits moyens de séquençement connectent électriquement ladite source d'alimentation de manière sélective à chaque circuit imprimé à bâti (70).
- 20 29. Un dispositif de visualisation d'image, correspondant à la revendication 28, où les moyens de séquençement en question (60) connectent électriquement la source d'alimentation en question à chaque circuit imprimé à bâti (70) des multiples circuits imprimés à bâti dans un ordre prédéfini.
- 25 30. Un dispositif de visualisation d'image, correspondant à la revendication 29, où les moyens de séquençement en question (60) connectent électriquement la source d'alimentation en question à chaque circuit imprimé à bâti (70) successif des multiples circuits imprimés à bâti à une vitesse prédéfinie.
- 30 31. Un dispositif de visualisation d'image, correspondant à la revendication 29, où la vitesse prédéfinie peut aller de 1 à 30 connexions de circuit imprimé à bâti par seconde et équivaut de préférence à 15 connexions de circuit imprimé à bâti par seconde.
- 35 32. Un dispositif de visualisation d'image, correspondant à la revendication 28, où chaque circuit imprimé à bâti (70) permet à une image prédéfinie d'être représentée par ledit dispositif.
- 40 33. Un dispositif de visualisation d'image, correspondant à la revendication 32, où les moyens de séquençement (60) connectent régulièrement la multitude de circuits imprimés à bâti à la source d'alimentation afin d'afficher sur cette visualisation d'image, une sélection d'images prédéfinies pour ainsi produire l'illusion d'une image en mouvement.
- 45 34. Un dispositif de visualisation d'image, correspondant à la revendication 29, où les moyens de séquençement (60) connectent électriquement ladite source d'alimentation (60) à chaque circuit imprimé à bâti successif (70) de cette multitude de circuits imprimés à bâti, sur demande grâce à un interrupteur adapté.
- 50 35. Un dispositif de visualisation d'image, correspondant à la revendication 34, où l'interrupteur en question peut être utilisé par un opérateur du dispositif.
- 55 36. Un dispositif de visualisation d'image, correspondant à la revendication 29, où les moyens de séquençement (60) fonctionnent par cycles consécutifs, où dans chaque cycle, les moyens de séquençement connectent électriquement la source d'alimentation (99) à chaque circuit imprimé à bâti (70) de la multitude des circuits imprimés à bâti dans l'ordre prédéfini.
37. Un dispositif de visualisation d'image, correspondant à la revendication 28, où les moyens de séquençement (60) comportent une puce de microprocesseur programmée de manière appropriée.
38. Un dispositif de visualisation d'image, correspondant à la revendication 29, où les moyens de séquençement (60) sont composés d'un interrupteur (610) pour le raccordement électrique entre au moins une paire de conducteurs électriques, l'un des conducteurs de cette paire pouvant être connecté électriquement à une source d'alimentation (99) appropriée, l'autre conducteur de la paire pouvant être connecté à un circuit imprimé à bâti correspondant (70) et ce premier interrupteur est composé de :

- un milieu liquide approprié qui n'est en grande partie pas un conducteur électrique (621) qui se présente sous la forme d'une boucle fermée (611) et disposant d'une surface supérieure libre ;
cette boucle fermée (611) est délimitée par au moins une paroi interne (633) et une paroi externe (632), ces parois interne et externe (632) étant concentriques l'une par rapport à l'autre et étant respectivement composées d'une partie de paroi interne supérieure (613) et d'une partie de paroi interne (613), dépassant le niveau moyen de la surface liquide libre ;
au moins une paire de conducteurs (626, 627), l'un des conducteurs provenant de cette même paire comprend un premier contact électrique approprié (626) sur cette partie de paroi interne supérieure et l'autre conducteur comprend un deuxième contact électrique approprié (627) sur cette partie de paroi externe supérieure ;
au moins un élément oscillant qui peut être activé électriquement (623) immergé dans ce milieu liquide (621) capable de procurer au moins une onde progressive sur cette surface libre en réponse à des vibrations appropriées ;
un élément de contact dynamique conducteur d'électricité (625), qui se trouve en grande partie sur cette surface libre et qui peut être porté par cette onde, cet élément de contact s'étendant au moins entre le premier contact électrique (626) et le deuxième contact électrique (627) ;
de cette manière, lorsque l'élément oscillant (623) vibre correctement, au moins une onde progressive apparaît sur la surface libre, portant ainsi l'élément dynamique (625) sur cette surface libre, alternativement dans une position procurant un contact électrique entre le premier contact (627) et le deuxième contact (626) et dans une position dans laquelle ce premier contact et ce deuxième contact (626, 627) sont électriquement déconnectés.
39. Un dispositif de visualisation d'image, correspondant à la revendication 38, où l'élément oscillant (623) est connecté de manière active à une quelconque source d'alimentation électrique appropriée (99).
 40. Un dispositif de visualisation d'image, correspondant à la revendication 38, où ce premier contact (626) et ce deuxième contact (627) composant chaque paire de conducteurs sont en grande partie placés face à face.
 41. Un dispositif de visualisation d'image, correspondant à la revendication 38, où ce premier interrupteur compte une multitude de paires de conducteurs (626, 627).
 42. Un dispositif de visualisation d'image, correspondant à la revendication 41, où les premiers contacts de chaque multitude de paires de conducteurs (626, 627) sont connectés électriquement entre eux.
 43. Un dispositif de visualisation d'image, correspondant à la revendication 42, où les premiers contacts de chaque multitude de paires de conducteurs (626, 627) se présentent sous la forme d'un seul contact électrique approprié.
 44. Un dispositif de visualisation d'image, correspondant à la revendication 42, où ce seul contact électrique se présente sous la forme d'une bande conductrice sur cette partie de paroi interne supérieure.
 45. Un dispositif de visualisation d'image, correspondant à la revendication 41, où les deuxièmes contacts de chaque multitude de paires de conducteurs sont connectés électriquement entre eux.
 46. Un dispositif de visualisation d'image, correspondant à la revendication 45, où les deuxièmes contacts de chaque multitude de paires de conducteurs (626, 627) se présentent sous la forme d'un seul contact électrique approprié.
 47. Un dispositif de visualisation d'image, correspondant à la revendication 45, où ce seul contact électrique se présente sous la forme d'une bande conductrice sur cette partie de paroi externe supérieure.
 48. Un dispositif de visualisation d'image, correspondant à la revendication 38, où cet élément de contact dynamique (625) est en grande partie sphérique.
 49. Un dispositif de visualisation d'image, correspondant à la revendication 38, où cet élément de contact dynamique (625) se compose d'une gouttelette liquide appropriée.
 50. Un dispositif de visualisation d'image, correspondant à la revendication 49, où cette gouttelette liquide se compose d'une gouttelette d'eau.
 51. Un dispositif de visualisation d'image, correspondant à la revendication 38, où le milieu liquide se compose d'un

liquide approprié, en ce compris l'huile.

52. Un dispositif de visualisation d'image, correspondant à la revendication 38, où cette boucle fermée (611) est en grande partie en forme d'anneau.
53. Un dispositif de visualisation d'image, correspondant à la revendication 28, où ces moyens de séquençement (60) comportent un deuxième interrupteur (710) pour le raccordement électrique entre au moins une paire de conducteurs électriques, l'un des conducteurs de cette paire pouvant être connecté électriquement à une source d'alimentation (99) appropriée, l'autre conducteur de la paire pouvant être connecté à un circuit imprimé à bâti correspondant et ce deuxième interrupteur (710) est composé de :
 - un anneau interne qui n'est quasiment pas conducteur d'électricité (735) et un anneau externe concentrique qui n'est quasiment pas conducteur d'électricité (725) ;
 - au moins une paire de conducteurs, l'un des conducteurs provenant de cette même paire comprend un premier contact électrique approprié (730) sur cet anneau interne (735) et l'autre conducteur comprend un deuxième contact électrique approprié (720) sur cet anneau externe (725) ;
 - un élément de contact dynamique conducteur d'électricité (770), s'étendant au moins entre le premier contact électrique (730) et le deuxième contact électrique (720) ;
 - un moteur approprié (750) correctement connecté de manière active à au moins un anneau interne (735), un anneau externe (725) et un élément de contact (770) de sorte à procurer un mouvement rotatif relatif entre ce premier élément de contact (770) et au moins un anneau interne (735) et un anneau externe (725) ;
 - de cette manière, lorsque le moteur en question (750) fournit un mouvement rotatif relatif approprié entre ce premier élément de contact (770) et au moins un anneau interne (735) et un anneau externe (725), l'élément dynamique (770) se trouve alternativement dans une position procurant un contact électrique entre le premier contact (730) et le deuxième contact (720) et dans une position dans laquelle ce premier contact (730) et ce deuxième contact (720) sont électriquement déconnectés.
54. Un dispositif de visualisation d'image, correspondant à la revendication 53, où ledit moteur (750) est un moteur électrique à plat qui peut être connecté de manière active à une quelconque source d'alimentation électrique appropriée (97).
55. Un dispositif de visualisation d'image, correspondant à la revendication 53, où ce premier contact (730) et ce deuxième contact (720) composant chaque paire de conducteurs sont en grande partie placés face à face.
56. Un dispositif de visualisation d'image, correspondant à la revendication 53, où ce deuxième interrupteur (710) comporte une multitude de ces paires de conducteurs.
57. Un dispositif de visualisation d'image, correspondant à la revendication 56, où ces premiers contacts (730) composant cette multitude de paires de conducteurs sont connectés électriquement entre eux.
58. Un dispositif de visualisation d'image, correspondant à la revendication 57, où ce premier contact (730) composant cette multitude de paires de conducteurs se présente sous la forme d'un seul contact électrique approprié.
59. Un dispositif de visualisation d'image, correspondant à la revendication 57, où ce seul contact électrique se présente sous la forme d'une bande conductrice sur cet anneau interne.
60. Un dispositif de visualisation d'image, correspondant à la revendication 57, où ces deuxièmes contacts (720) composant cette multitude de paires de conducteurs sont connectés électriquement entre eux.
61. Un dispositif de visualisation d'image, correspondant à la revendication 60, où ce deuxième contact (720) composant cette multitude de paires de conducteurs se présente sous la forme d'un seul contact électrique approprié.
62. Un dispositif de visualisation d'image, correspondant à la revendication 60, où ce seul contact électrique se présente sous la forme d'une bande conductrice sur cet anneau externe.
63. Un dispositif de visualisation d'image, correspondant à la revendication 53, où cet anneau interne (735) et cet anneau externe (725) sont en grande partie statiques, et cet élément dynamique (735) est porté de manière appropriée sur un bras du rotor (760) connecté de manière active audit moteur (750) capable de pivoter autour de

l'axe commun de cet anneau interne (735) et de cet anneau externe (725).

64. Un dispositif de visualisation d'image, correspondant à la revendication 53, où cet élément de contact dynamique (770) comporte un conducteur électrique approprié.

65. Un dispositif de visualisation d'image, correspondant à la revendication 28, où ces moyens de séquençement (60) sont composés d'un troisième interrupteur (810) pour le raccordement électrique entre un premier conducteur électrique et une multitude de conducteurs de puissance électrique, ce premier conducteur électrique pouvant être connecté électriquement à une source d'alimentation appropriée et chaque conducteur de puissance électrique pouvant être connecté à un circuit imprimé à bâti correspondant et ce troisième interrupteur (810) est composé de :

une base (860) ;

une multitude de contacts bimétalliques (850), chacun d'entre eux étant correctement fixé par une première extrémité (871) à la base en question (860), ces contacts bimétalliques (850) pouvant être déformés de manière réversible, en partant d'une première configuration pour adopter une deuxième configuration, en réponse à un changement de température prédéfini de ce contact bimétallique (850), de sorte que la deuxième extrémité (872) de ce contact bimétallique (850) soit déplacée en conséquence respectivement d'une première position vers une deuxième position ;

un premier conducteur électrique (820) connecté électriquement au moins à chaque première extrémité (871) de ces contacts bimétalliques (850) ;

un deuxième conducteur électrique (82) espacé de la base en question (860), la deuxième extrémité (872) de chaque contact bimétallique (850) étant en grande partie libre d'aller et venir entre la première et la deuxième position et étant respectivement capable d'établir et de couper le contact électrique existant entre le contact bimétallique (850) et le deuxième conducteur électrique (82) ;

ce premier conducteur électrique (820) et ce deuxième conducteur électrique (82) pouvant être connectés de manière active à une source d'alimentation électrique appropriée (99) ;

ces contacts bimétalliques (850) pouvant être électriquement chauffés à au moins un changement de température prédéfini lorsque les deuxièmes extrémités (872) sont en contact électrique avec ce deuxième conducteur (82) ;

une multitude de conducteurs de puissance électrique (830), où chaque conducteur de puissance en question (830) est correctement placé par rapport à la deuxième extrémité (872) d'un contact bimétallique correspondant (850) de sorte que le conducteur de puissance (830) ne puisse entrer en contact électrique commun avec ce même contact bimétallique correspondant (850) et ce deuxième conducteur (82) que lorsque ce contact bimétallique correspondant (850) est en contact électrique avec ce deuxième conducteur (82) ;

où la vitesse de chauffe et de refroidissement de l'une des multitudes de contacts bimétalliques (850) peut être différente respectivement de la vitesse de chauffe ou de refroidissement d'un autre contact bimétallique (850), où cette différence au niveau de la vitesse de chauffe ou de refroidissement permet au moins à un conducteur de sortie (830) d'être électriquement connecté à un contact bimétallique correspondant (850) et à ce deuxième conducteur (82) alors que cet autre conducteur de sortie (830) est simultanément déconnecté électriquement de son contact bimétallique correspondant (850) et du conducteur électrique en question (82).

66. Un dispositif de visualisation d'image, correspondant à la revendication 65, où ce premier conducteur électrique (820) et ce deuxième conducteur électrique (82) sont électriquement connectés à une source d'alimentation électrique appropriée (99).

67. Un dispositif de visualisation d'image, correspondant à la revendication 65, où ce premier conducteur électrique (820) et cette base (860) sont intégraux.

68. Un dispositif de visualisation d'image, correspondant à la revendication 65, où ce premier conducteur électrique (820) et ce deuxième conducteur électrique (82) sont en grande partie parallèles.

69. Un dispositif de visualisation d'image, correspondant à la revendication 65, où ce conducteur de puissance électrique (830) est correctement fixé au contact bimétallique correspondant (850).

70. Un dispositif de visualisation d'image, correspondant à la revendication 65, comportant en outre au moins un contact bimétallique commun (850) placé en série avec ce premier conducteur électrique (820) et/ou ce deuxième conducteur électrique (82).

71. Un dispositif de visualisation d'image, correspondant à la revendication 70, où ce contact bimétallique commun (850) est doté d'une vitesse de chauffe beaucoup plus lente que la vitesse de chauffe de l'un quelconque de cette multitude de contacts bimétalliques (850).
- 5 72. Un dispositif de visualisation d'image, correspondant à la revendication 70, où ce contact bimétallique commun (850) est doté d'une vitesse de refroidissement beaucoup plus lente que la vitesse de refroidissement de l'un quelconque de cette multitude de contacts bimétalliques (850).
- 10 73. Un dispositif de visualisation d'image, correspondant à la revendication 65, où ces multiples contacts bimétalliques (850) sont en grande partie parallèles les uns par rapport aux autres.
- 15 74. Un dispositif de visualisation d'image, correspondant à la revendication 28, où ces moyens de séquençement (60) sont composés d'un interrupteur (910) pour le raccordement électrique entre un premier conducteur électrique et une multitude de conducteurs de puissance électrique, ce premier conducteur électrique pouvant être connecté électriquement à une source d'alimentation appropriée et chaque conducteur de puissance électrique pouvant être connecté à un circuit imprimé à bâti correspondant et ce quatrième interrupteur (910) est composé de :
- une base (960) ;
- 20 une multitude d'éléments piézoélectriques appropriés (950), chaque élément piézoélectrique (950) pouvant être correctement fixé par une première extrémité (971) à ladite base (960), chaque élément piézoélectrique (950) vibrant entre une première amplitude et une deuxième amplitude en réponse à l'approvisionnement en courant et/ou tension électrique approprié fourni à cet élément piézoélectrique (950), de sorte que la deuxième extrémité (972) de chaque élément piézoélectrique (950) soit déplacée en conséquence, respectivement d'une première vers une deuxième position ;
- 25 un premier conducteur électrique (920) connecté électriquement à l'une des premières extrémités (971) de ces éléments piézoélectriques (950) ;
- un deuxième conducteur électrique (92) espacé de la base en question (960), la deuxième extrémité (972) de chaque élément piézoélectrique (950) étant en grande partie libre d'aller et venir entre la première et la deuxième position et étant respectivement capable d'établir et de couper le contact électrique existant entre
- 30 les éléments piézoélectriques (950) et le deuxième conducteur électrique (92) ;
- ce premier conducteur électrique (920) et ce deuxième conducteur électrique (92) pouvant être connectés de manière active à une source d'alimentation électrique appropriée (99) ;
- ces éléments piézoélectriques (950) vibrent lorsque les deuxièmes extrémités sont en contact électrique avec le deuxième conducteur (92) ;
- 35 une multitude de conducteurs de puissance électrique (930), où chaque conducteur de puissance en question (930) est correctement placé par rapport à la deuxième extrémité (972) d'un élément piézoélectrique correspondant (950) de sorte que le conducteur de puissance (930) ne puisse entrer en contact électrique commun avec ce même élément piézoélectrique correspondant (950) et ce deuxième conducteur que lorsque cet élément piézoélectrique correspondant (950) est en contact électrique avec ce deuxième conducteur (92) ;
- 40 où la phase de vibration d'au moins un des multiples éléments piézoélectriques (950) peut être différente de la phase de vibration d'au moins un autre élément piézoélectrique et où la différence perçue au niveau des phases permet au moins à un conducteur de puissance (930) d'être connecté électriquement à un élément piézoélectrique correspondant (950) et à ce deuxième conducteur (92) alors qu'au moins un autre conducteur de puissance (930) est simultanément déconnecté électriquement de son élément piézoélectrique correspondant (950) et du conducteur électrique en question.
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- 50 75. Un dispositif de visualisation d'image, correspondant à la revendication 74, où ce premier conducteur électrique (920) et ce deuxième conducteur électrique (92) sont électriquement connectés à une source d'alimentation électrique appropriée (99).
76. Un dispositif de visualisation d'image, correspondant à la revendication 74, où ce premier conducteur électrique (920) et cette base (960) sont intégraux.
- 55 77. Un dispositif de visualisation d'image, correspondant à la revendication 74, où ce premier conducteur électrique (920) et ce deuxième conducteur électrique (92) sont en grande partie parallèles.
78. Un dispositif de visualisation d'image, correspondant à la revendication 74, où au moins ce conducteur de puissance électrique (930) est correctement fixé à l'élément piézoélectrique correspondant (950).

79. Un dispositif de visualisation d'image, correspondant à la revendication 74, où ces multiples éléments piézoélectriques (950) sont en grande partie parallèles les uns par rapport aux autres.
- 5 80. Un dispositif de visualisation d'image, correspondant à la revendication 74, où cette différence au niveau de la phase de vibration entre les éléments piézoélectriques adjacents (950) est obtenue en connectant sous tension la source d'alimentation aux premières extrémités de ces multiples éléments piézoélectriques (950) à une vitesse prédéfinie.
- 10 81. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, adapté de sorte à pouvoir être utilisé comme un écran pour un système de divertissement en vol.
82. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, adapté de sorte à pouvoir être utilisé comme un écran pour un distributeur électronique ou électromécanique.
- 15 83. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, adapté de sorte à pouvoir être utilisé comme un écran de jeu électronique.
84. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où le dispositif en question peut être fixé à un article de fabrication.
- 20 85. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où le dispositif en question peut être fixé à un conditionnement.
86. Un dispositif de visualisation d'image, tel qu'il est déclaré dans la revendication 1, où le dispositif en question fait partie intégrante dudit conditionnement.
- 25 87. Un dispositif de visualisation d'image, correspondant à la revendication 1, comportant en outre une interface appropriée en vue d'utiliser le dispositif en question comme un écran adapté, qui puisse être utilisé en option avec un ordinateur, un téléviseur ou tout autre appareil vidéo ou téléphonique.
- 30 88. Un dispositif de visualisation d'image, correspondant à la revendication 26, où les cartes du circuit à bâti sont correctement configurées de sorte à permettre à ce dispositif d'afficher des images correspondant à du matériel normalement imprimé, en ce compris les textes et les images.
- 35 89. Un dispositif de visualisation d'image, correspondant à la revendication 26, où les cartes du circuit à bâti sont correctement configurées de sorte à permettre à ce dispositif d'afficher des images correspondant au matériel imprimé, ce qui inclut un ou plusieurs des matériels suivants : un livre, un journal, un magazine, une revue, un manuel, une carte de vœux, une carte personnelle, une carte de saison, une carte de visite, un prospectus publicitaire, les affranchissements et autres timbres, une carte postale, un auto-collant, une étiquette, une affiche, 40 une bannière, un drapeau, un emblème, un badge, un prospectus, un guide illustré, une carte, une image et des brochures publicitaires imprimées, entre autres.
90. Un dispositif de visualisation d'image, correspondant à la revendication 26, comportant en outre un chronomètre approprié connecté de manière active à celui-ci, où les cartes du circuit à bâti en question sont correctement configurées de sorte à permettre audit dispositif d'afficher des images correspondant à l'heure et/ ou à la date.
- 45 91. Un dispositif de visualisation d'image, correspondant à la revendication 26, comportant en outre un appareil de mesure approprié connecté de manière active à celui-ci, où les cartes du circuit à bâti en question sont correctement configurées de sorte à permettre audit dispositif d'afficher des images correspondant à l'intensité d'une variante quantifiée par ce mètre.
- 50 92. Un dispositif de visualisation d'image, correspondant à la revendication 26, comportant en outre un chronomètre approprié connecté de manière active à celui-ci, où les cartes du circuit à bâti en question sont correctement configurées de sorte à permettre audit dispositif d'afficher des images différentes correspondant à la date et/ ou l'heure.
- 55 93. Utilisation d'un dispositif de visualisation d'image correspondant à la revendication 26, où le dispositif en question est correctement configuré comme un panneau de signalisation routière.

94. Utilisation d'un dispositif de visualisation d'image correspondant à la revendication 26, où le dispositif en question est adapté de sorte à être utilisé comme un billet de loterie.
- 5 95. Utilisation d'un dispositif de visualisation d'image correspondant à la revendication 26, où le dispositif en question est adapté de sorte à être utilisé comme une carte de crédit.
96. Utilisation d'un dispositif de visualisation d'image correspondant à la revendication 26, où le dispositif en question est adapté de sorte à être utilisé comme une carte ou une pièce d'identité.
- 10 97. Utilisation d'un dispositif de visualisation d'image correspondant à la revendication 26, où le dispositif en question est adapté de sorte à être utilisé comme un panneau d'affichage à usage extérieur.

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Figure 1

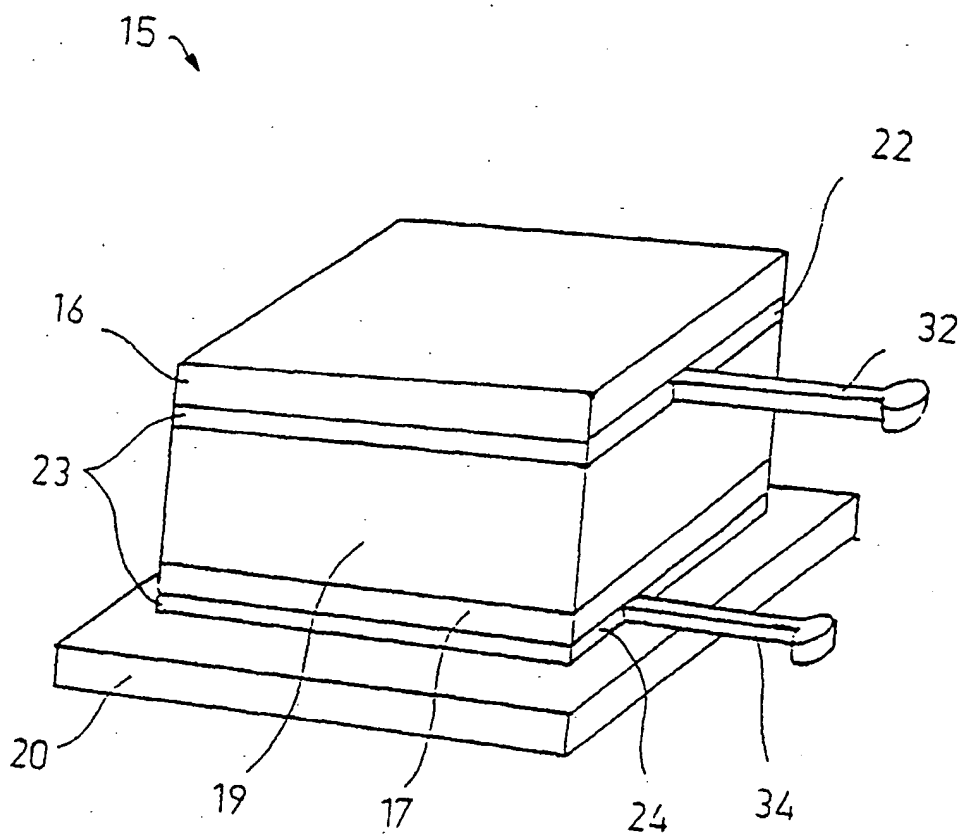
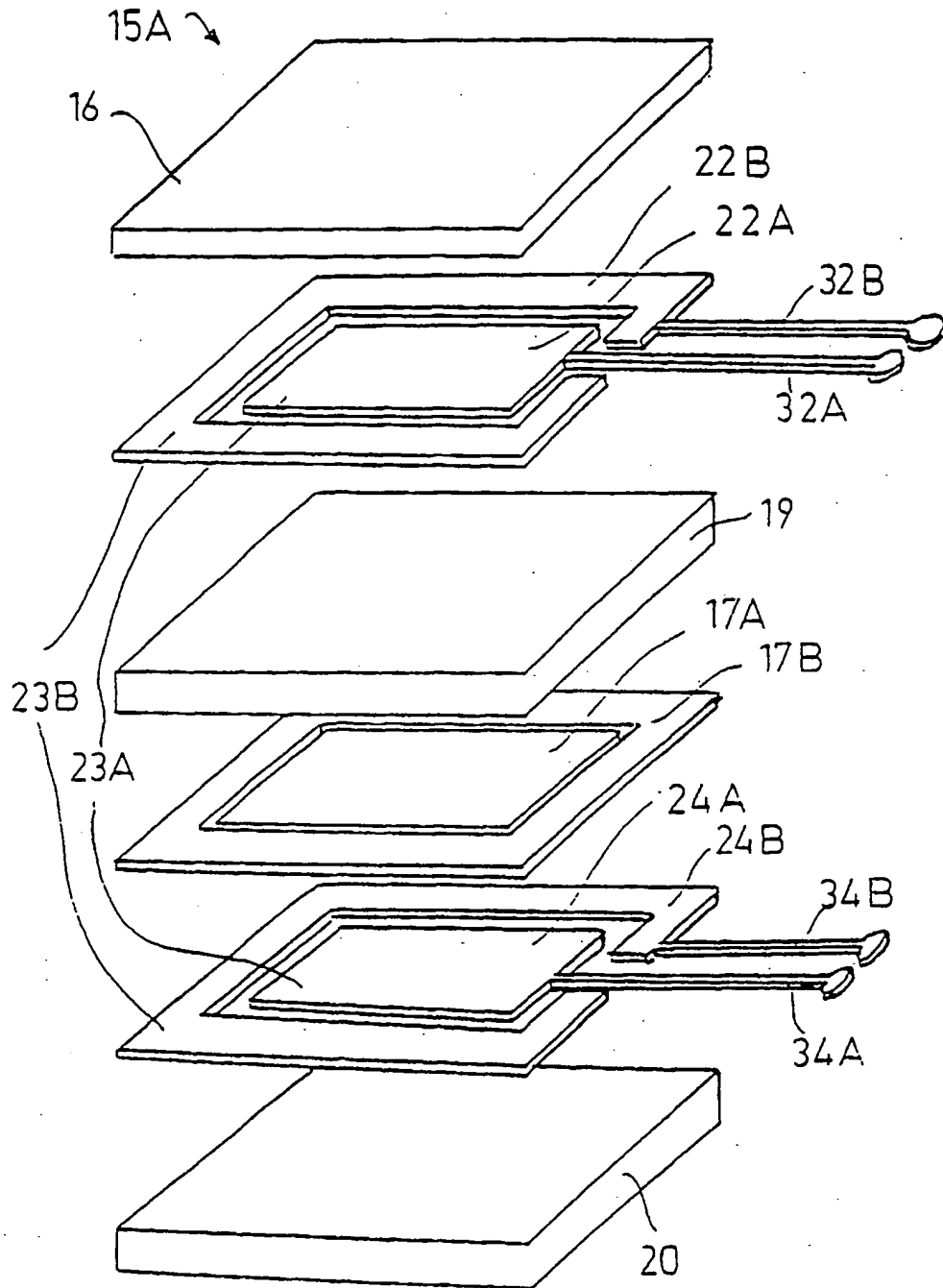


Figure 2



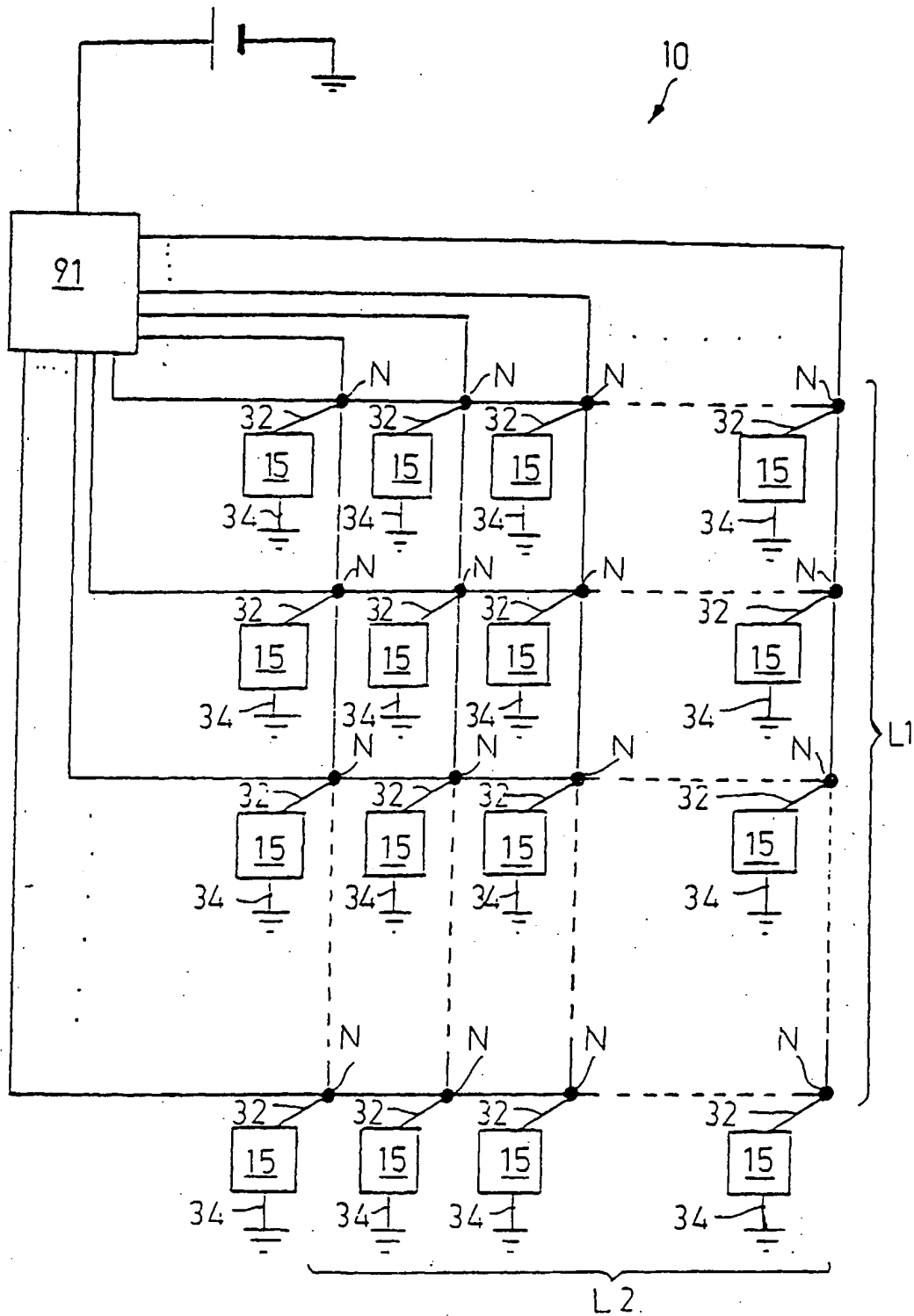
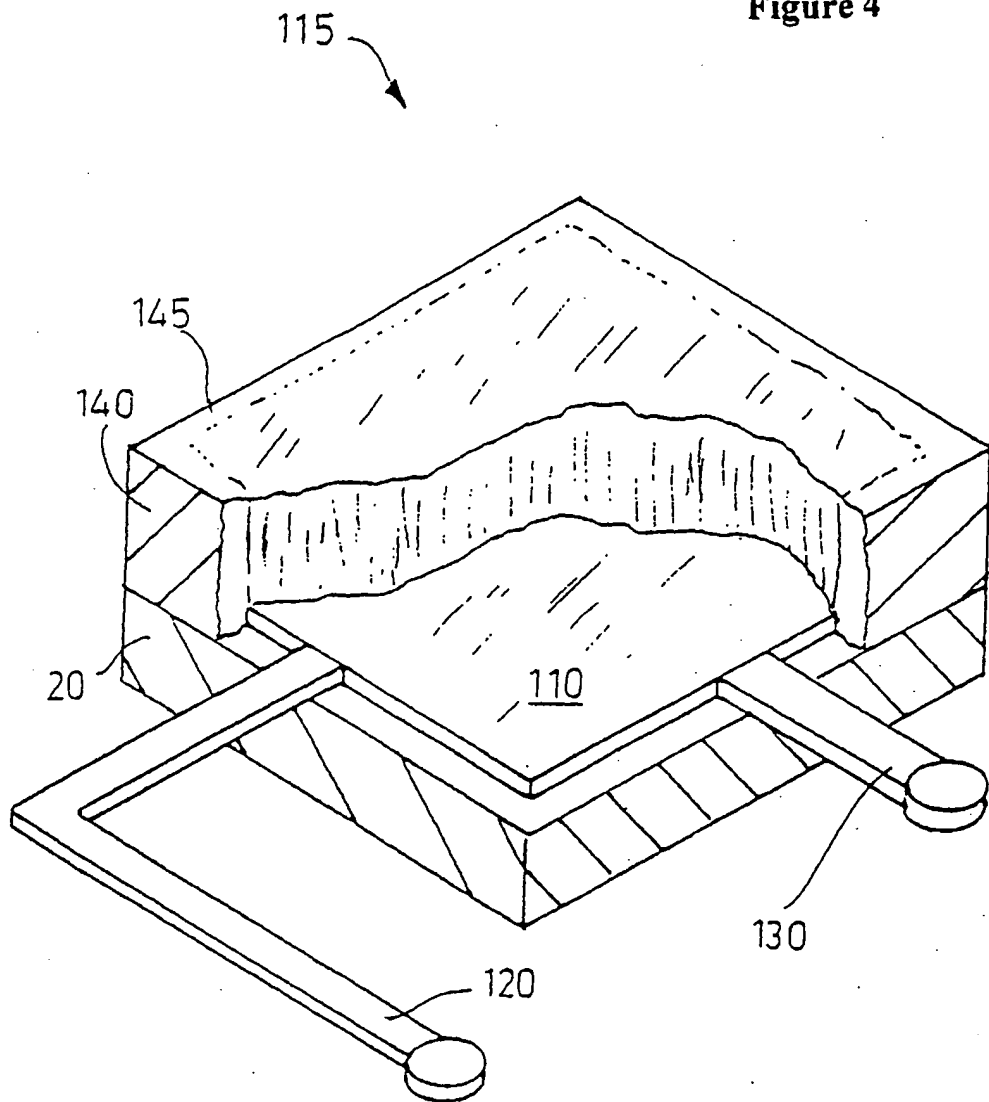


Figure 3

Figure 4



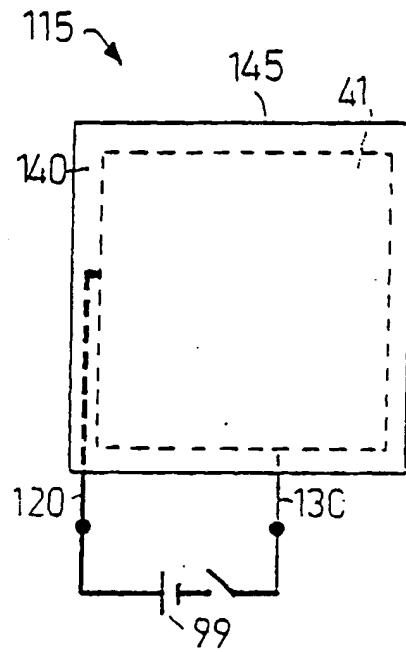


Figure 5(a)

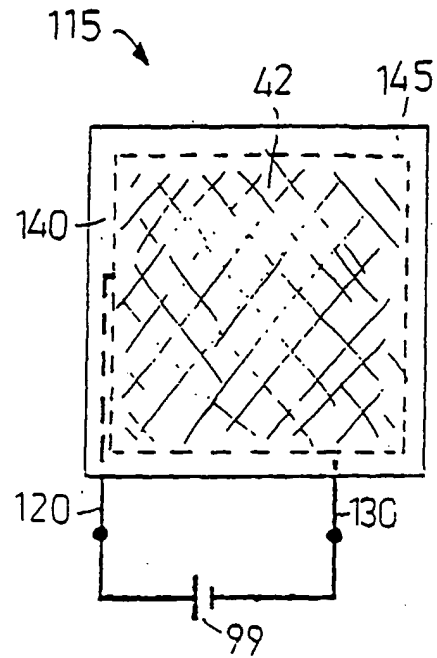


Figure 5(b)

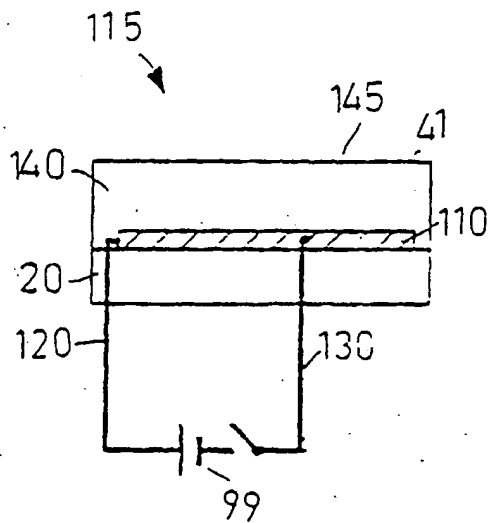


Figure 5(c)

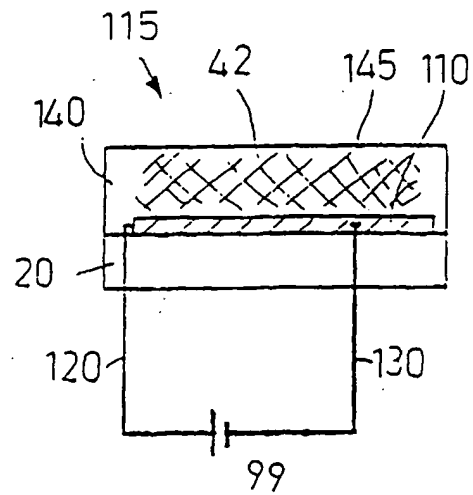


Figure 5(d)

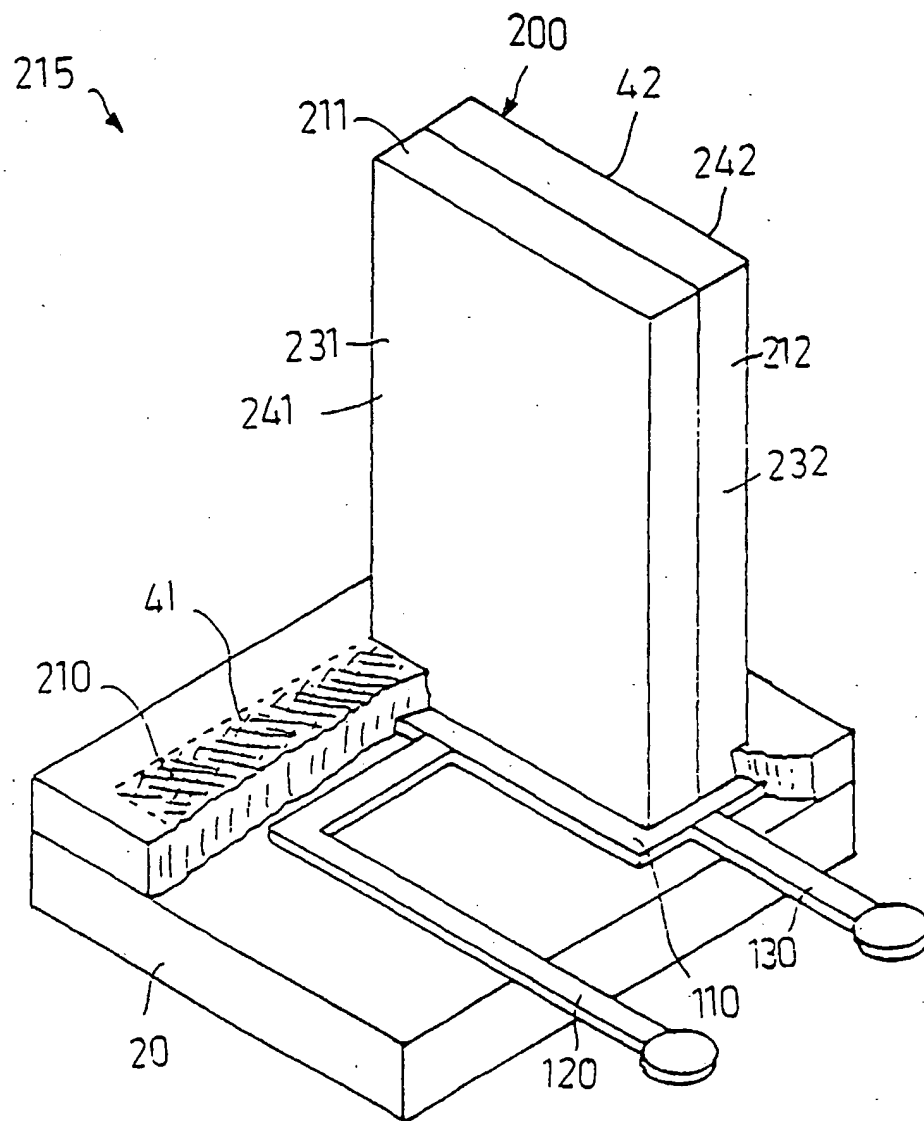


Figure 6

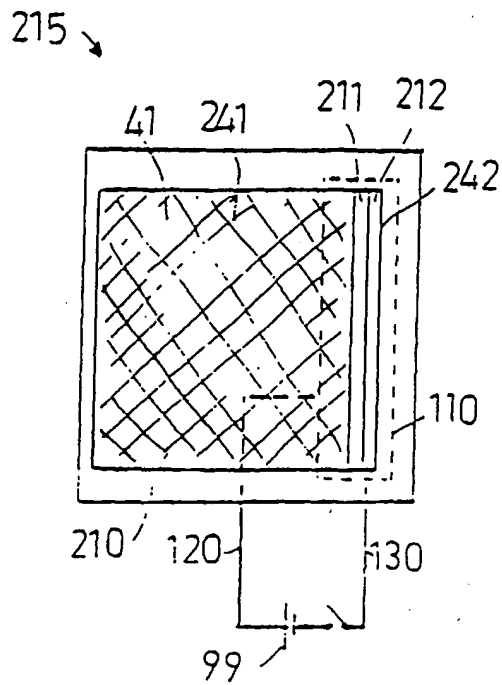


Figure 7(a)

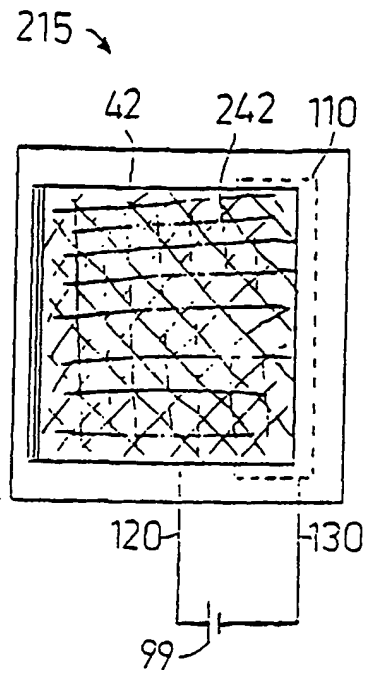


Figure 7(b)

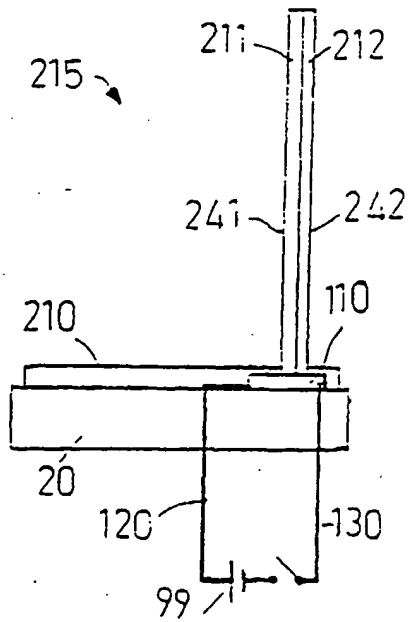


Figure 7(c)

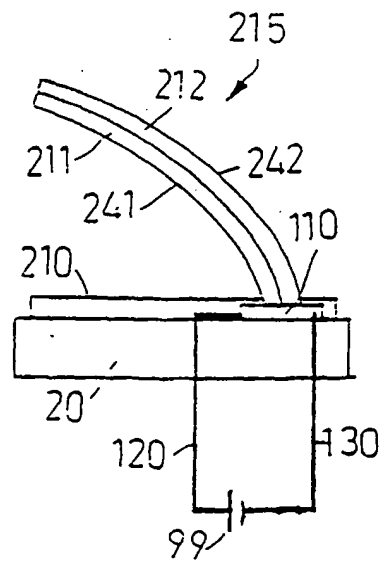


Figure 7(d)

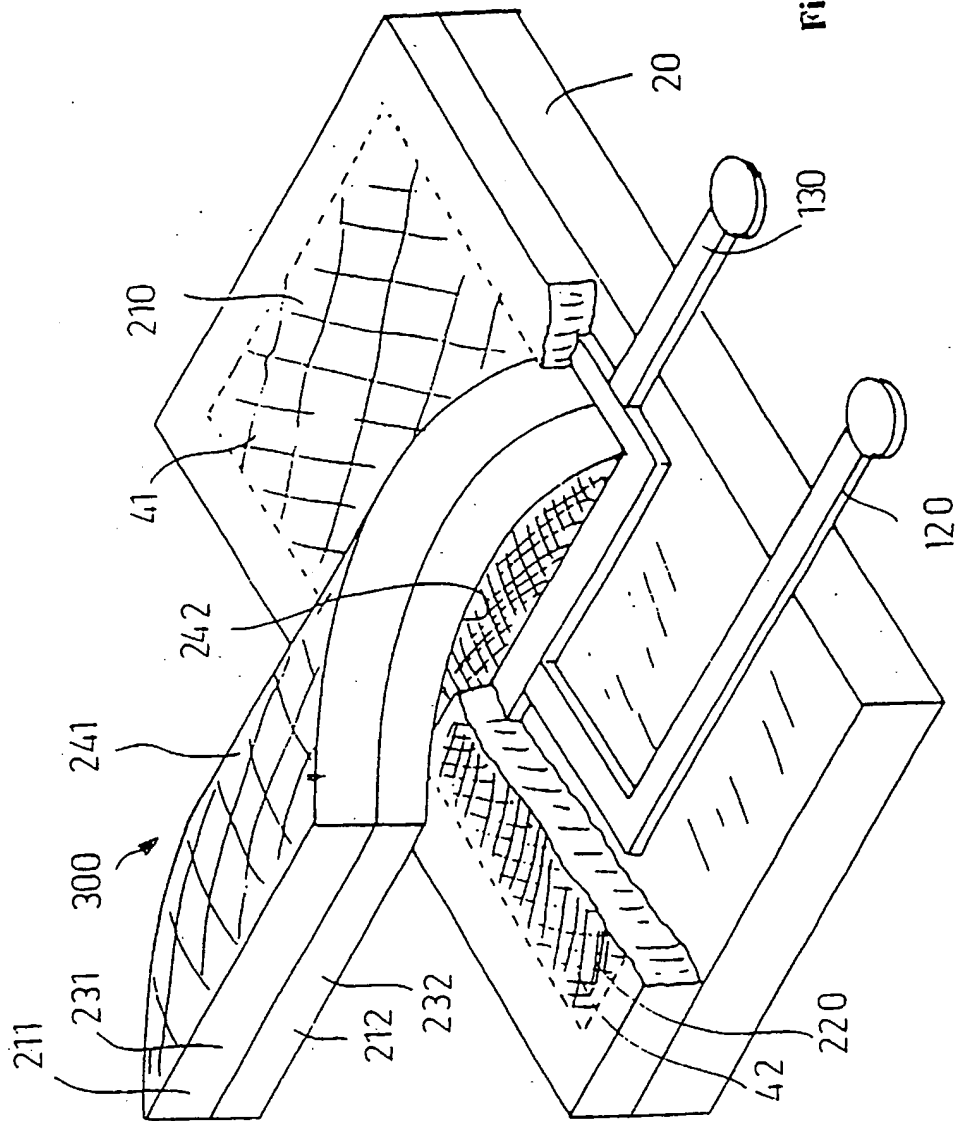


Figure 8

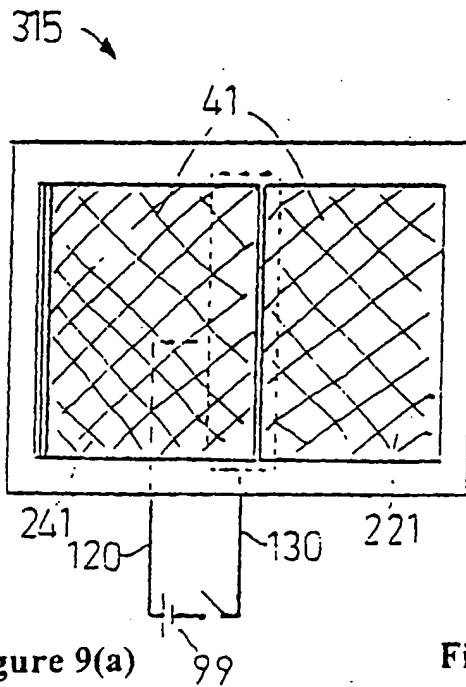


Figure 9(a)

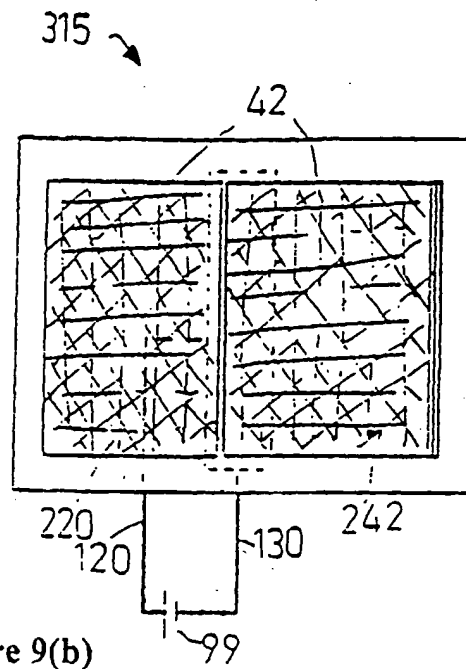


Figure 9(b)

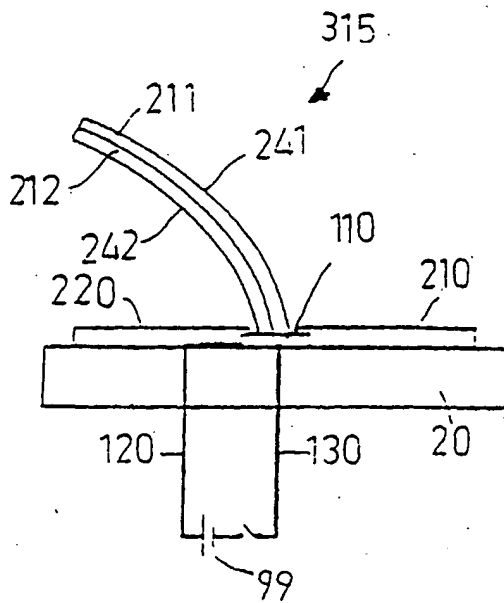


Figure 9(c)

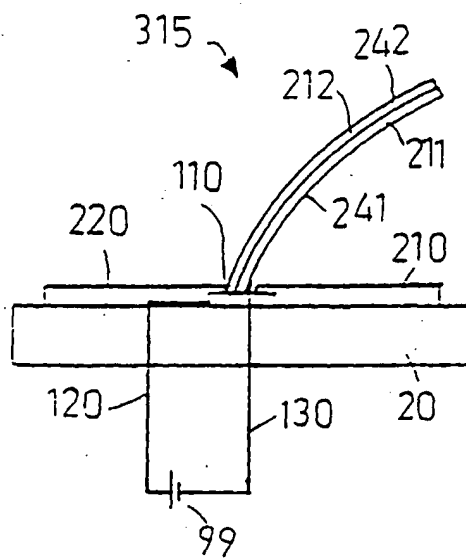


Figure 9(d)

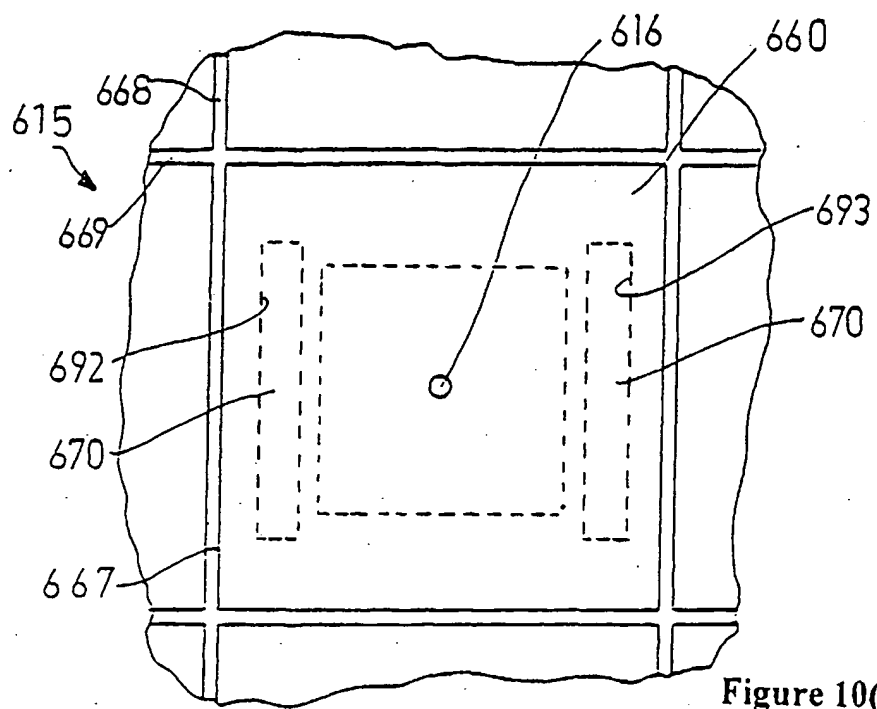


Figure 10(a)

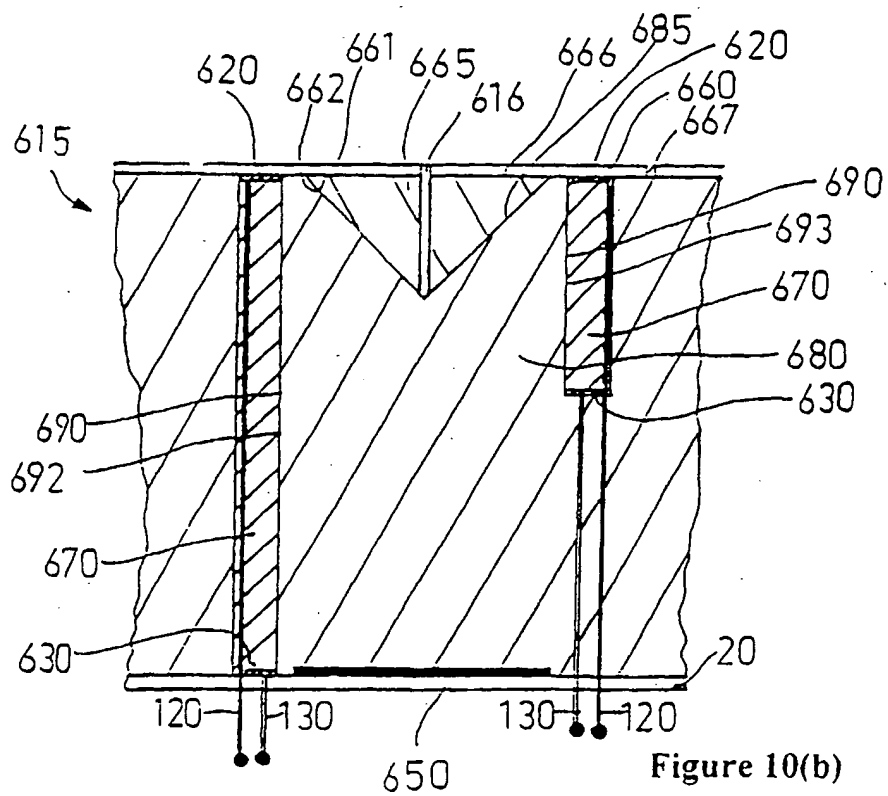


Figure 10(b)

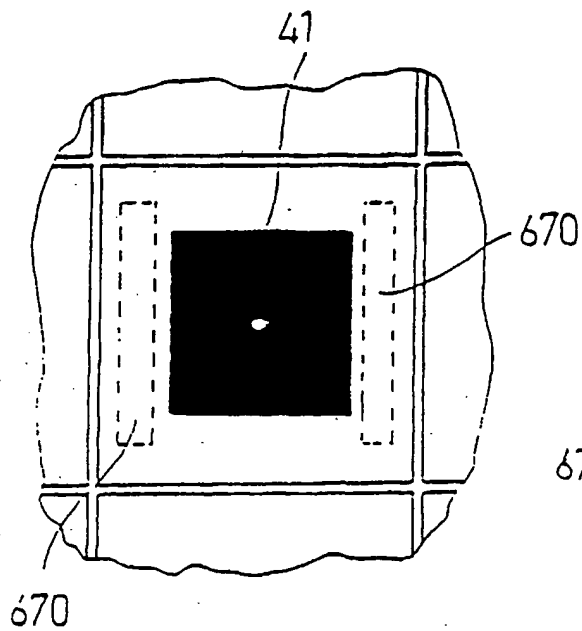


Figure 11(a)

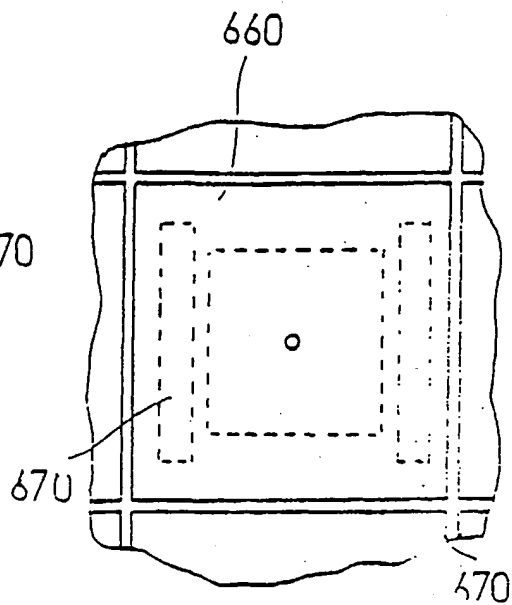


Figure 11(b)

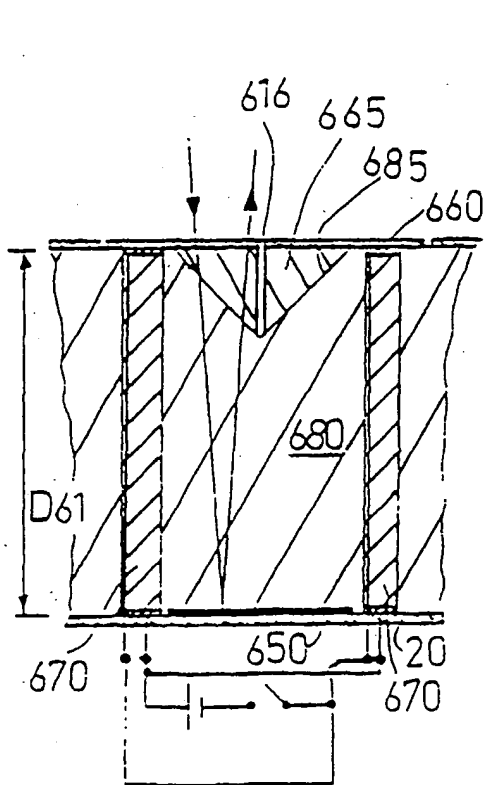


Figure 11(c)

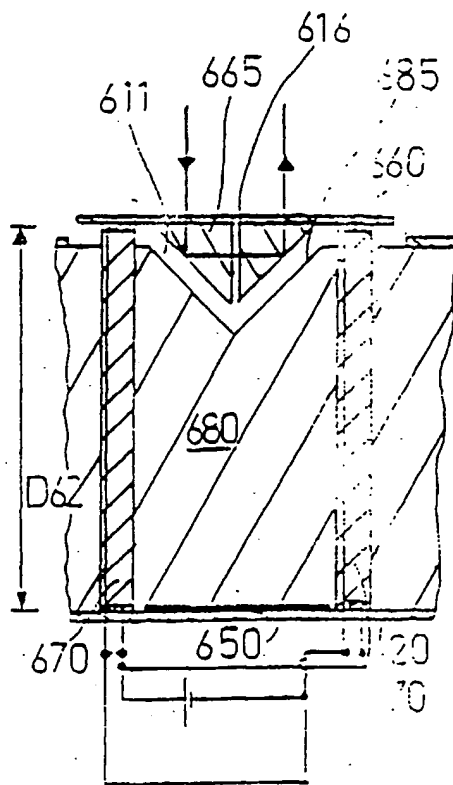


Figure 11(d)

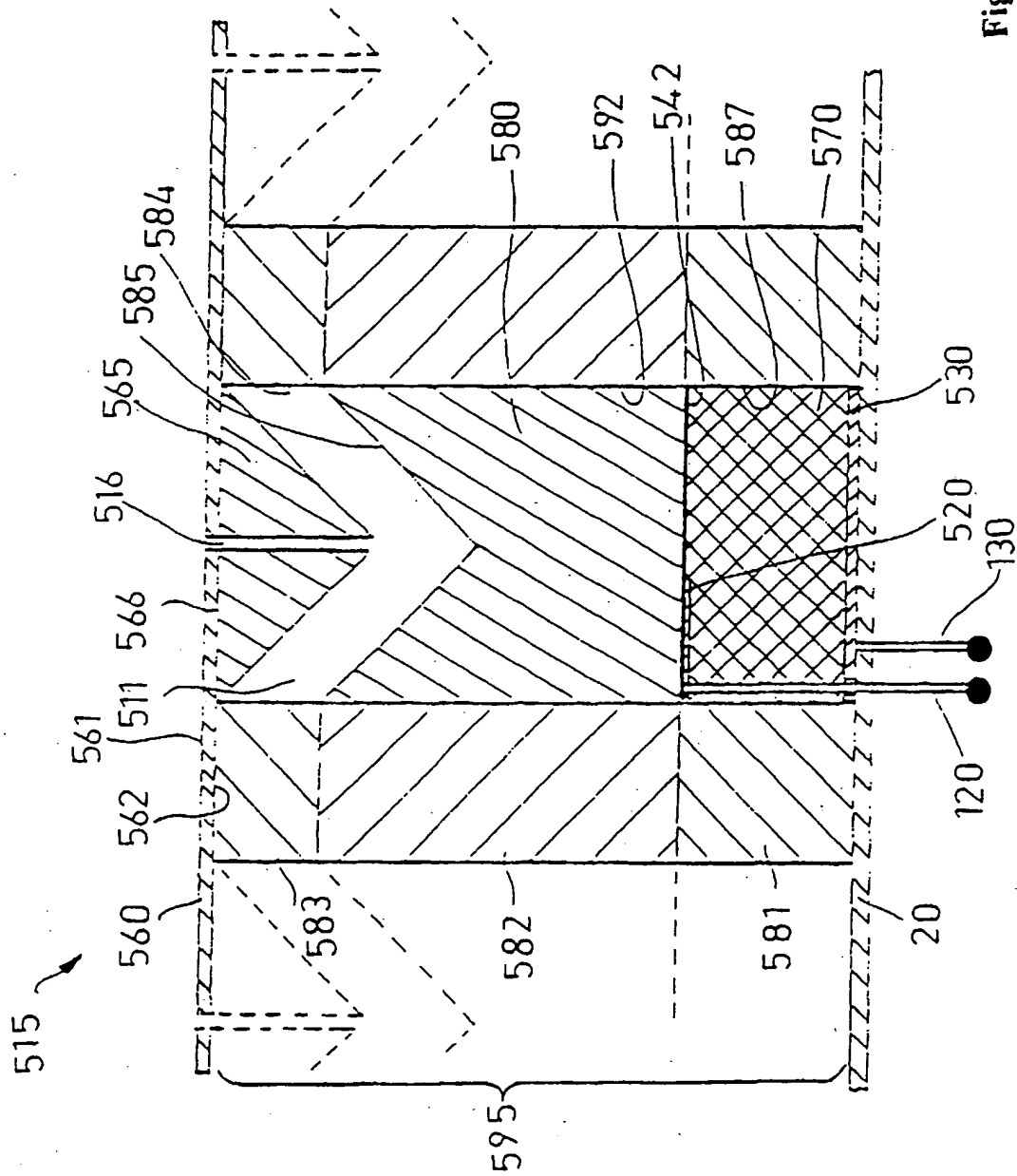


Figure 12

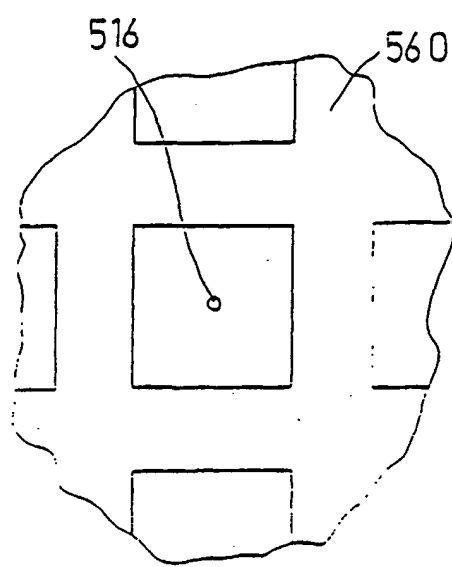


Figure 13(a)

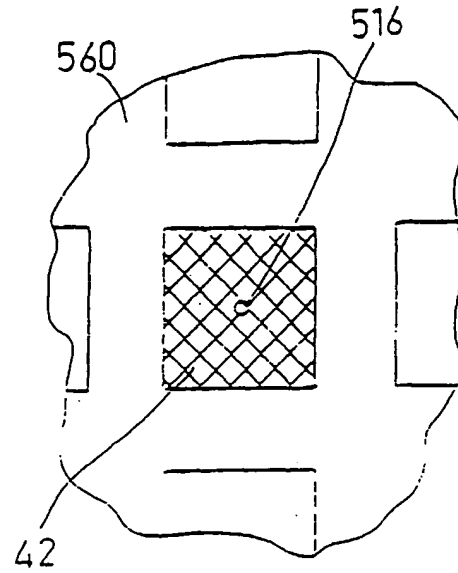


Figure 13(b)

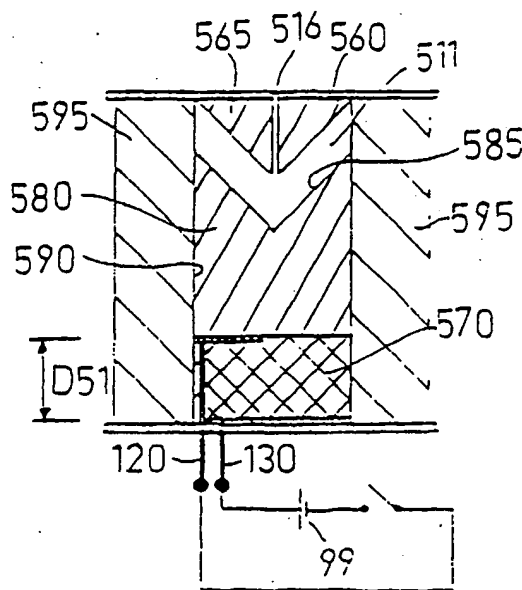


Figure 13(c)

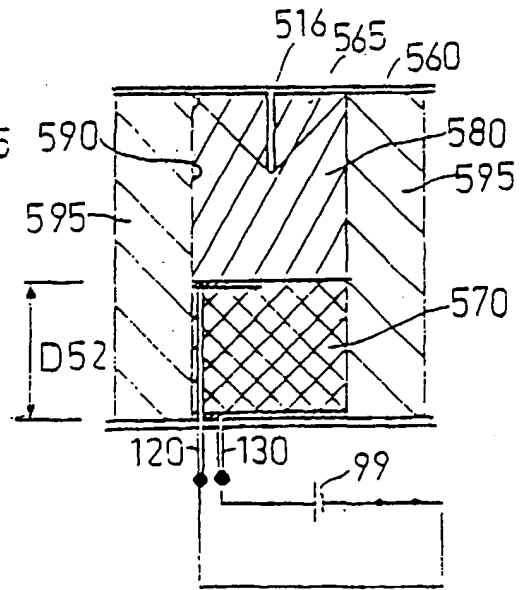


Figure 13(d)

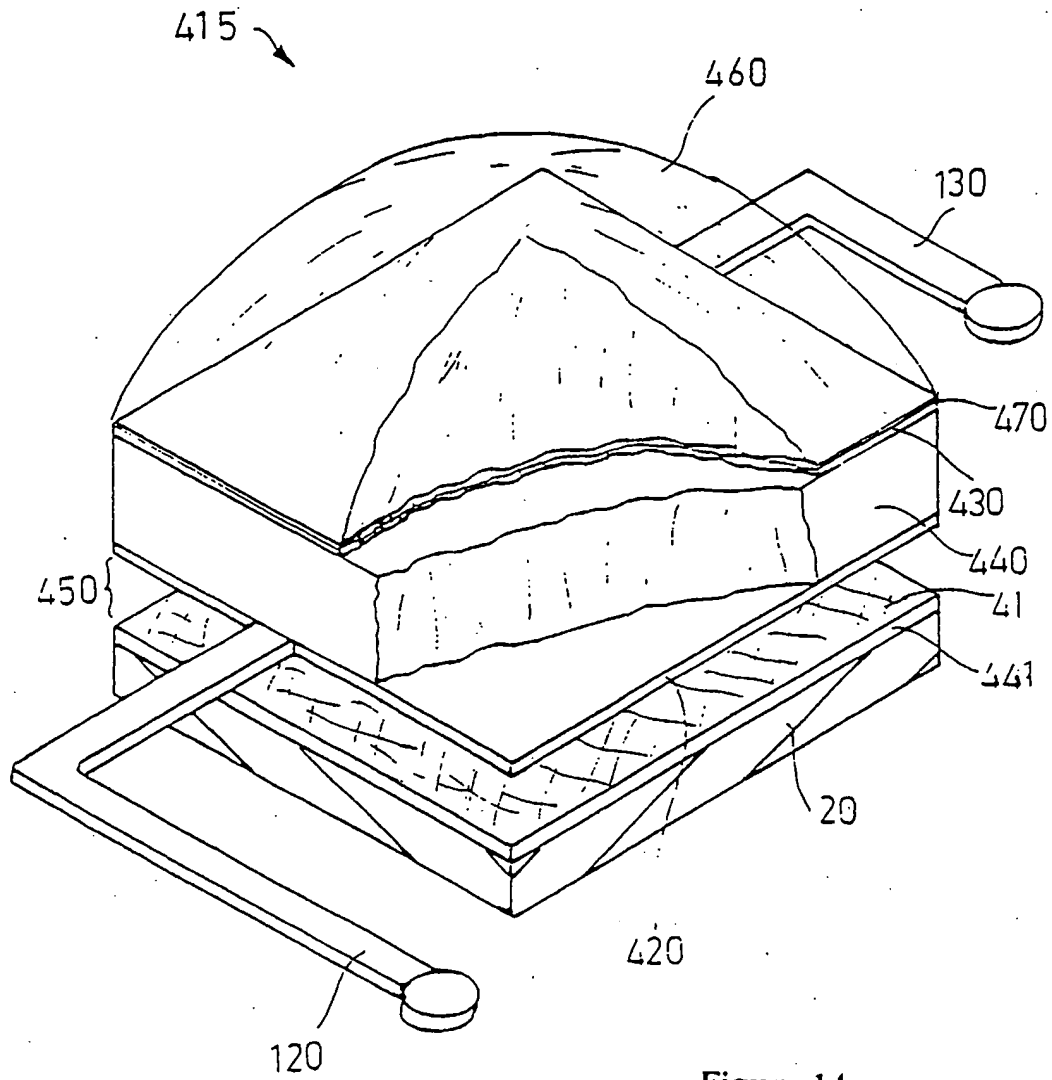


Figure 14

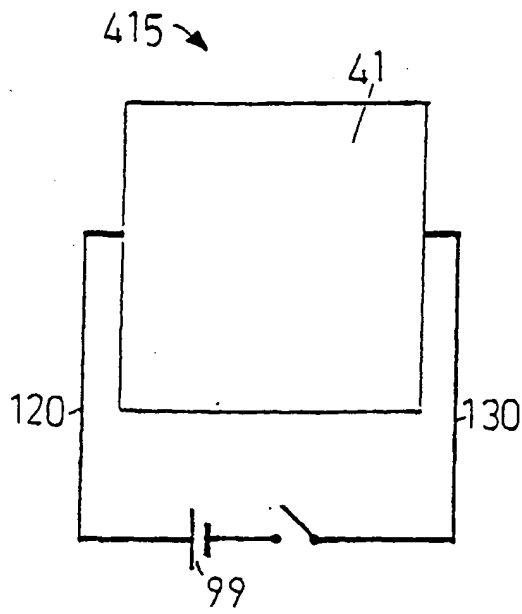


Figure 15(a)

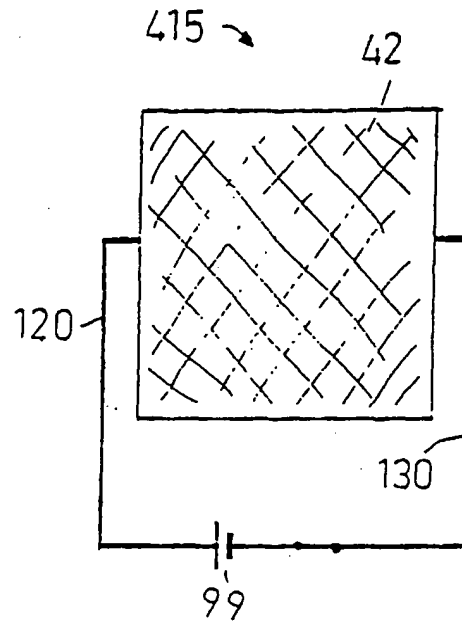


Figure 15(b)

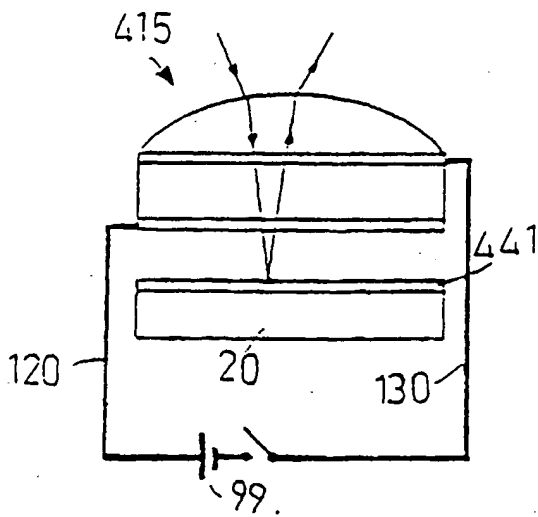


Figure 15(c)

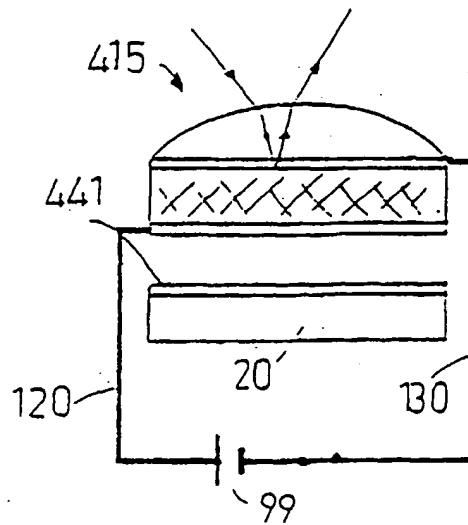


Figure 15(d)

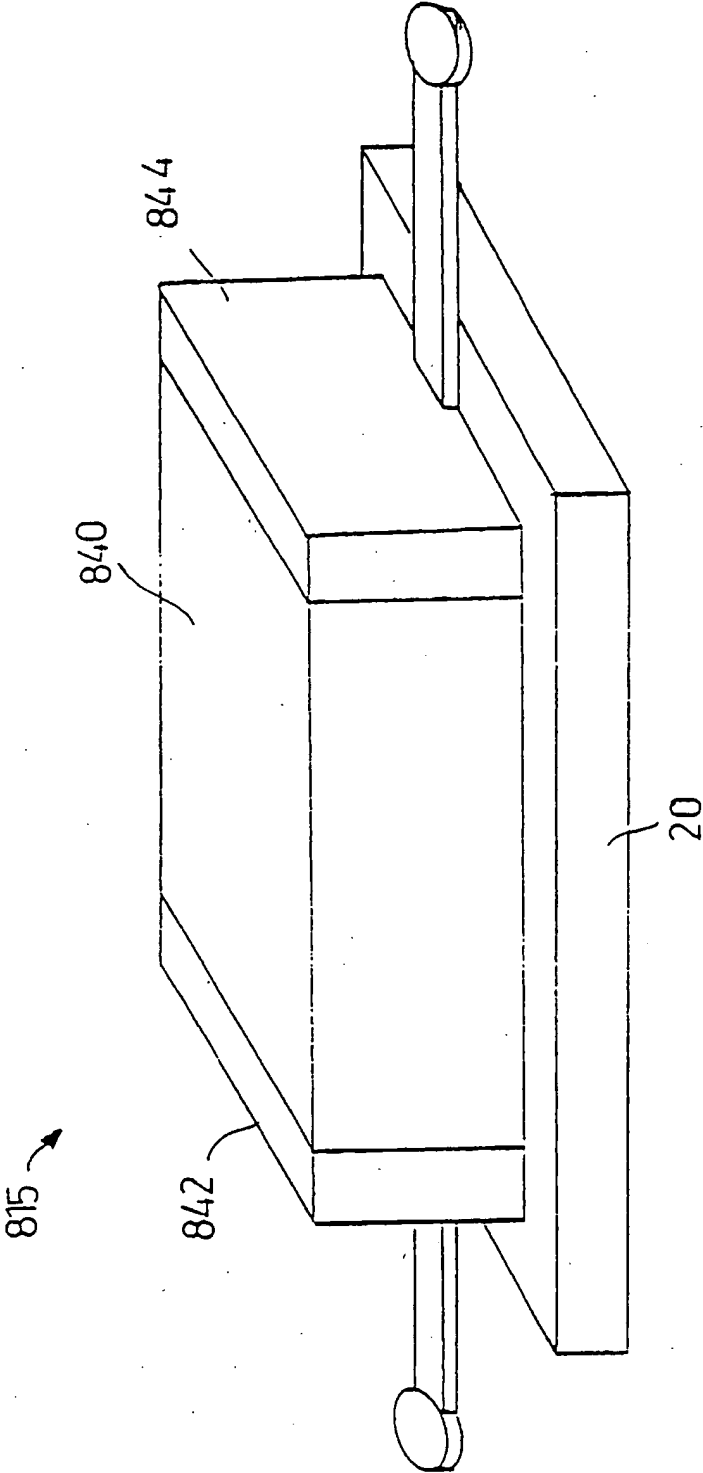


Figure 16

Figure 17

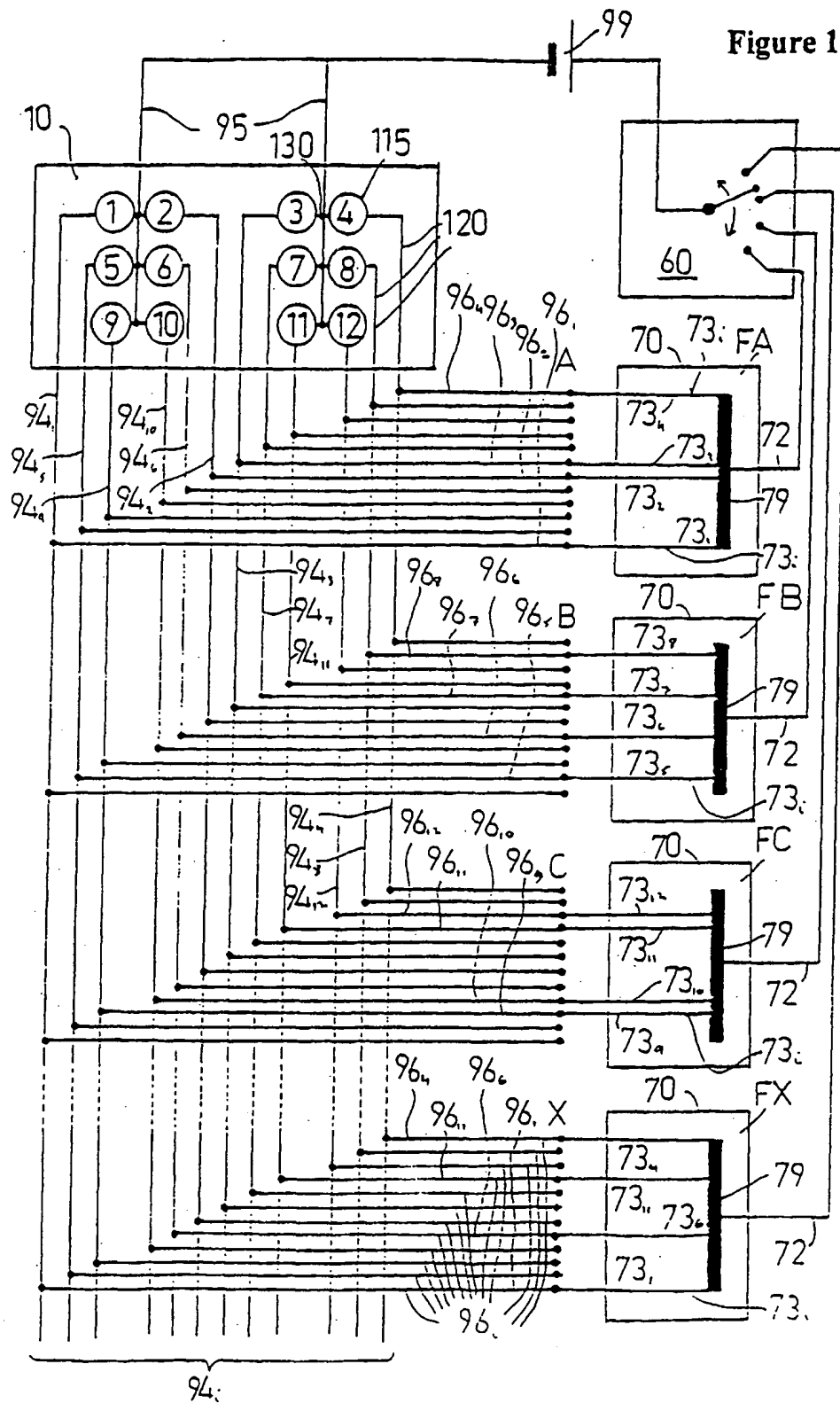


Figure 18

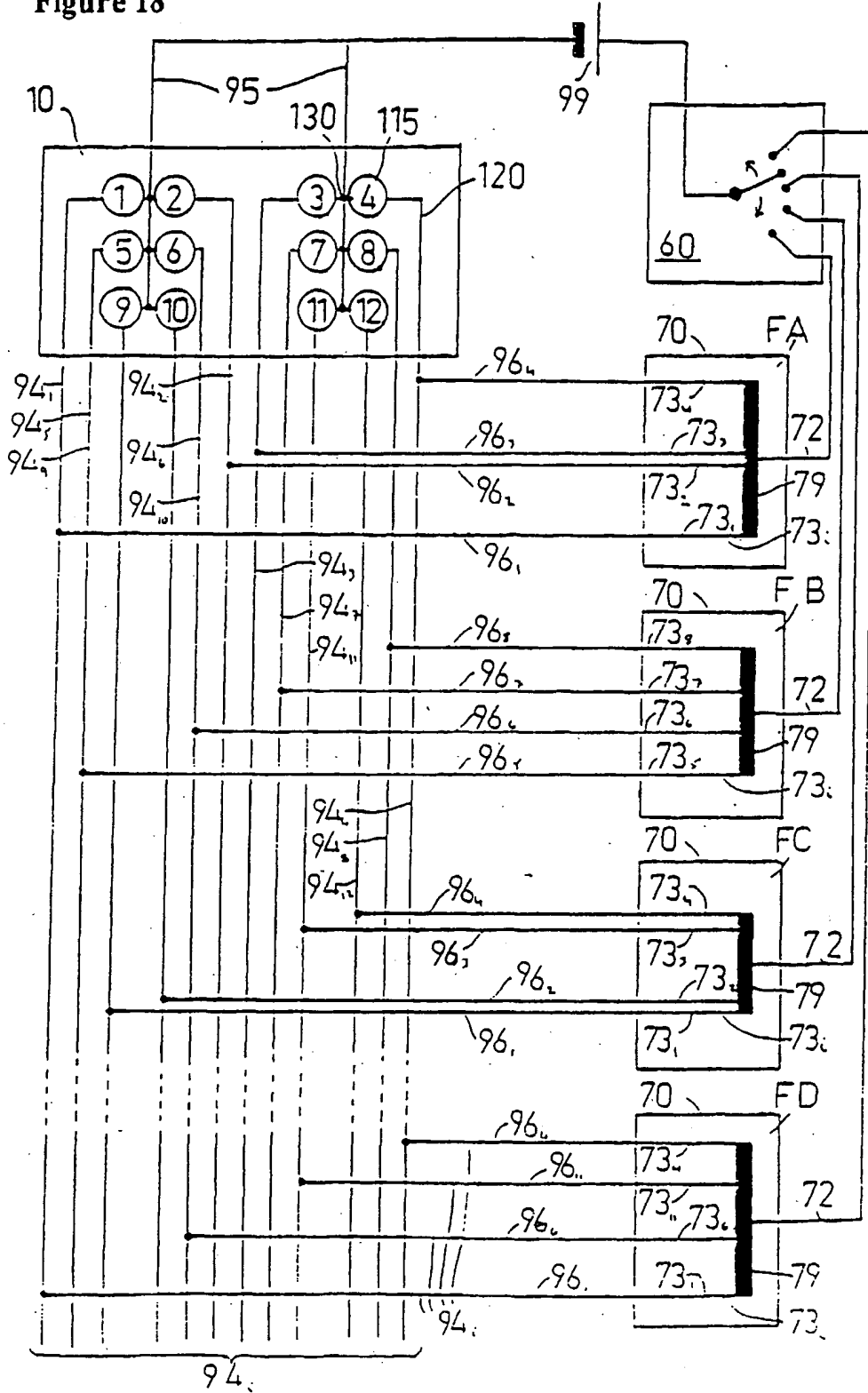


Figure 19(a)

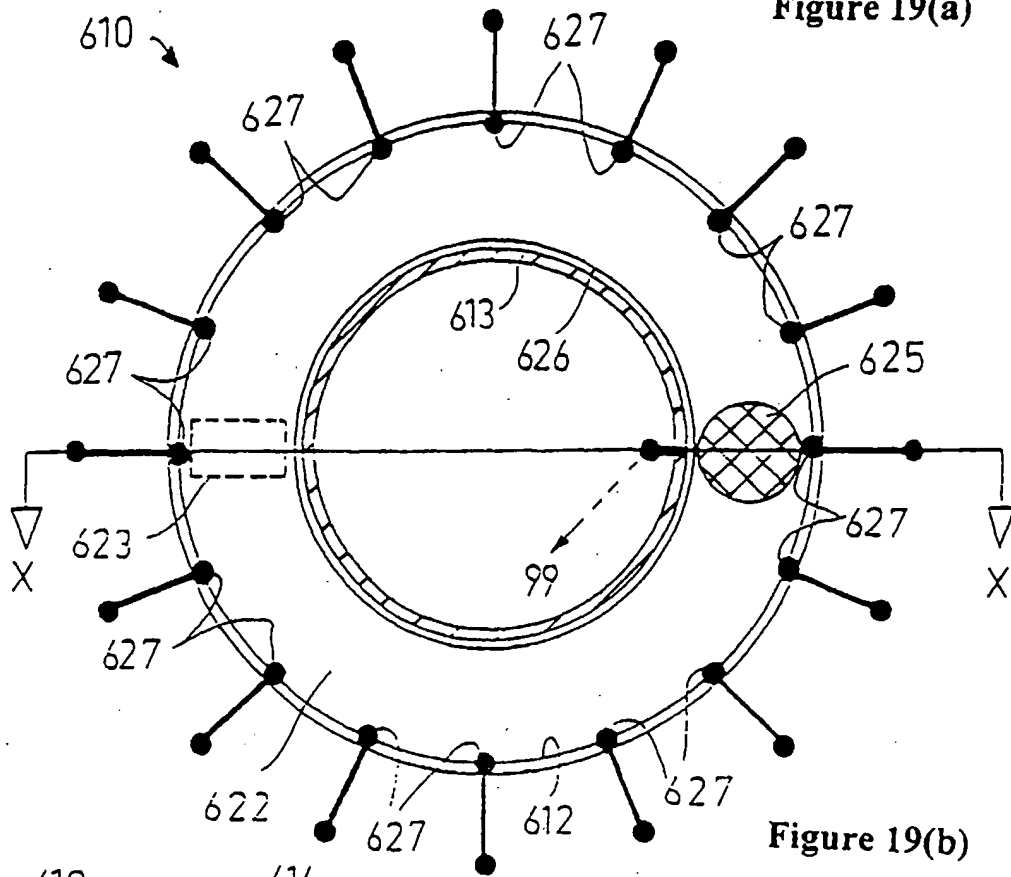
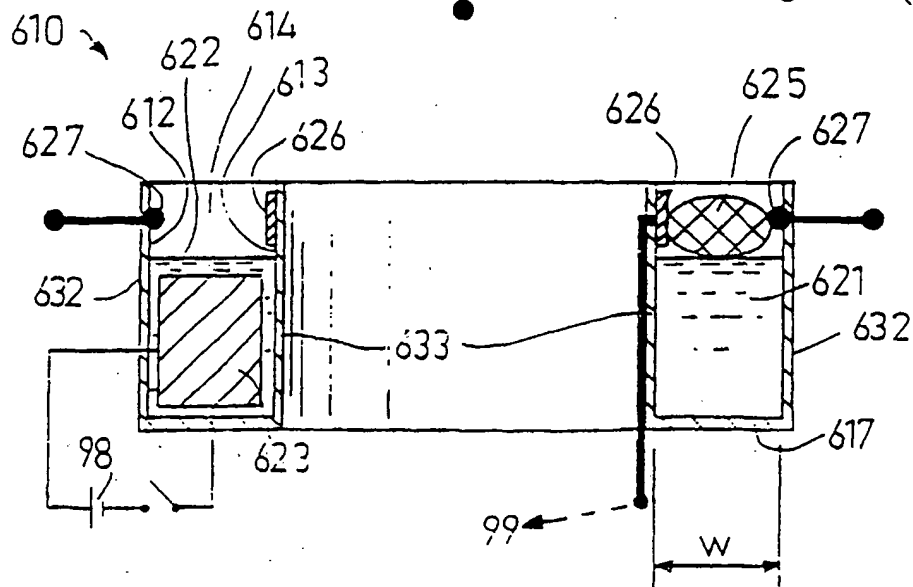
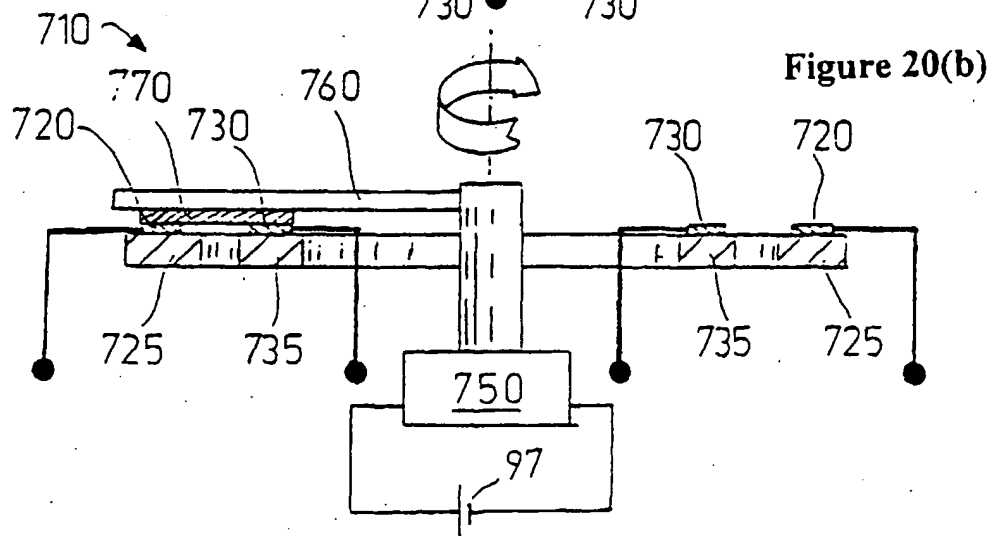
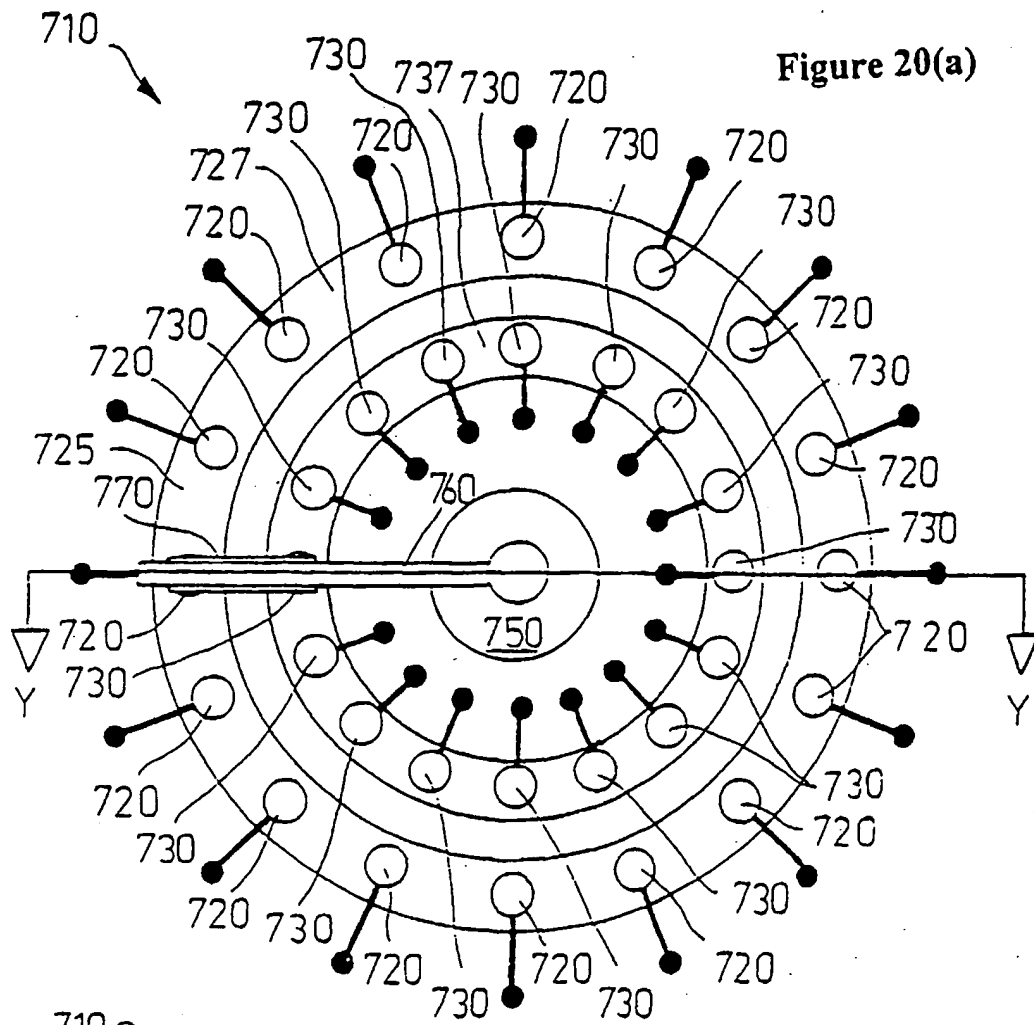


Figure 19(b)





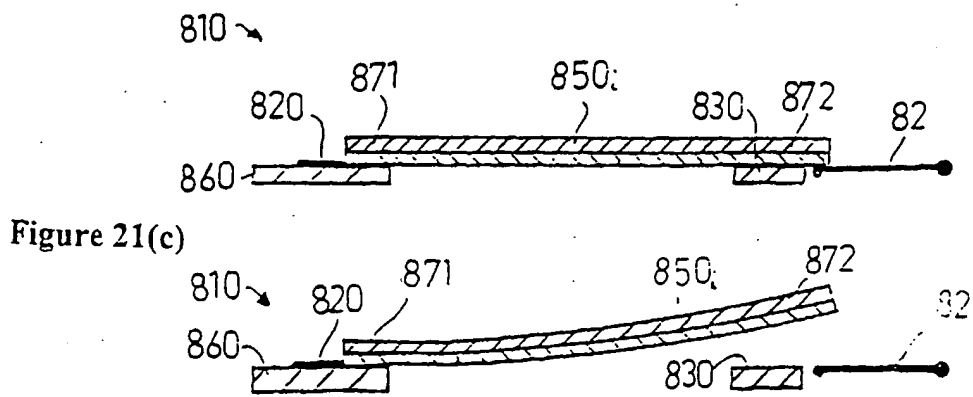
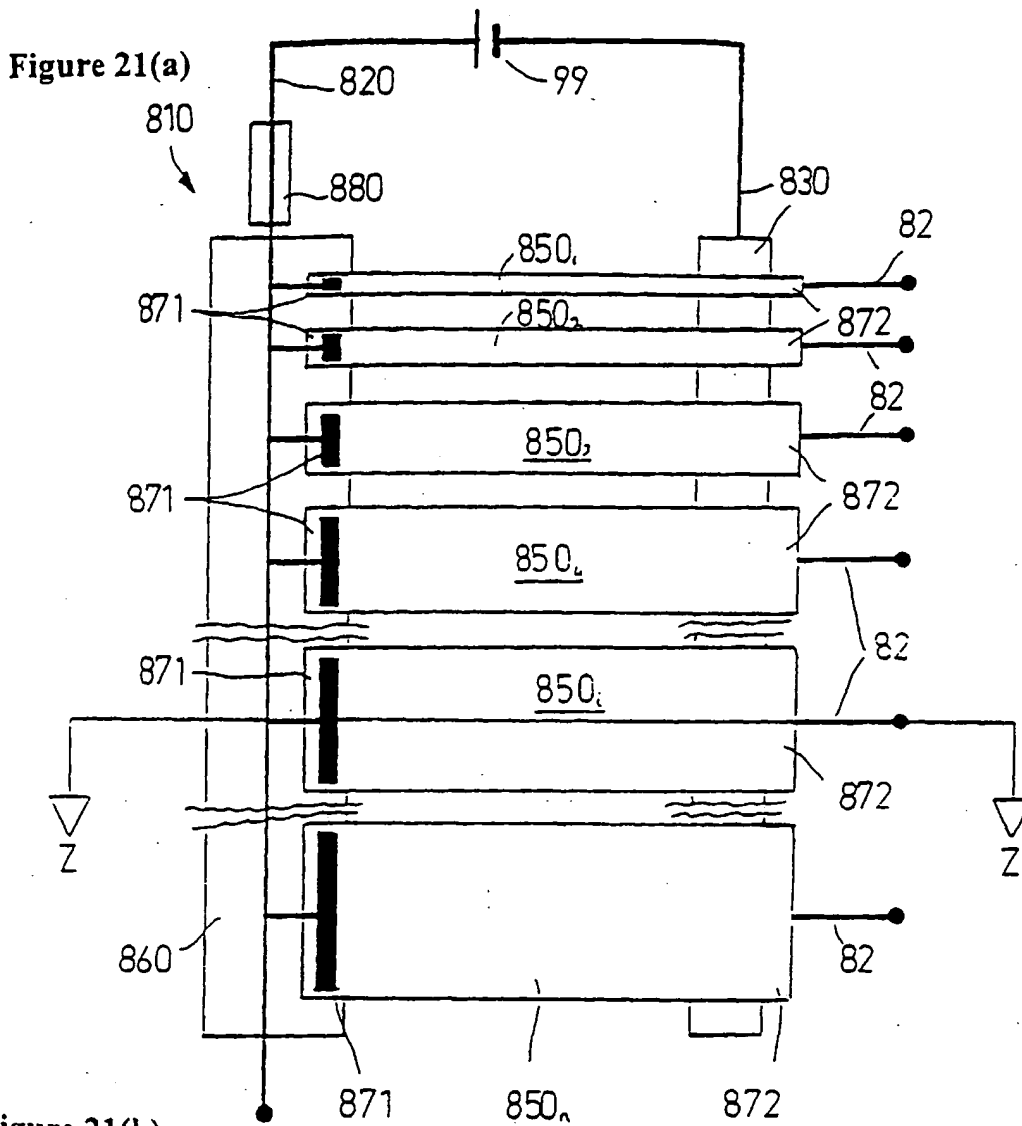


Figure 22(a)

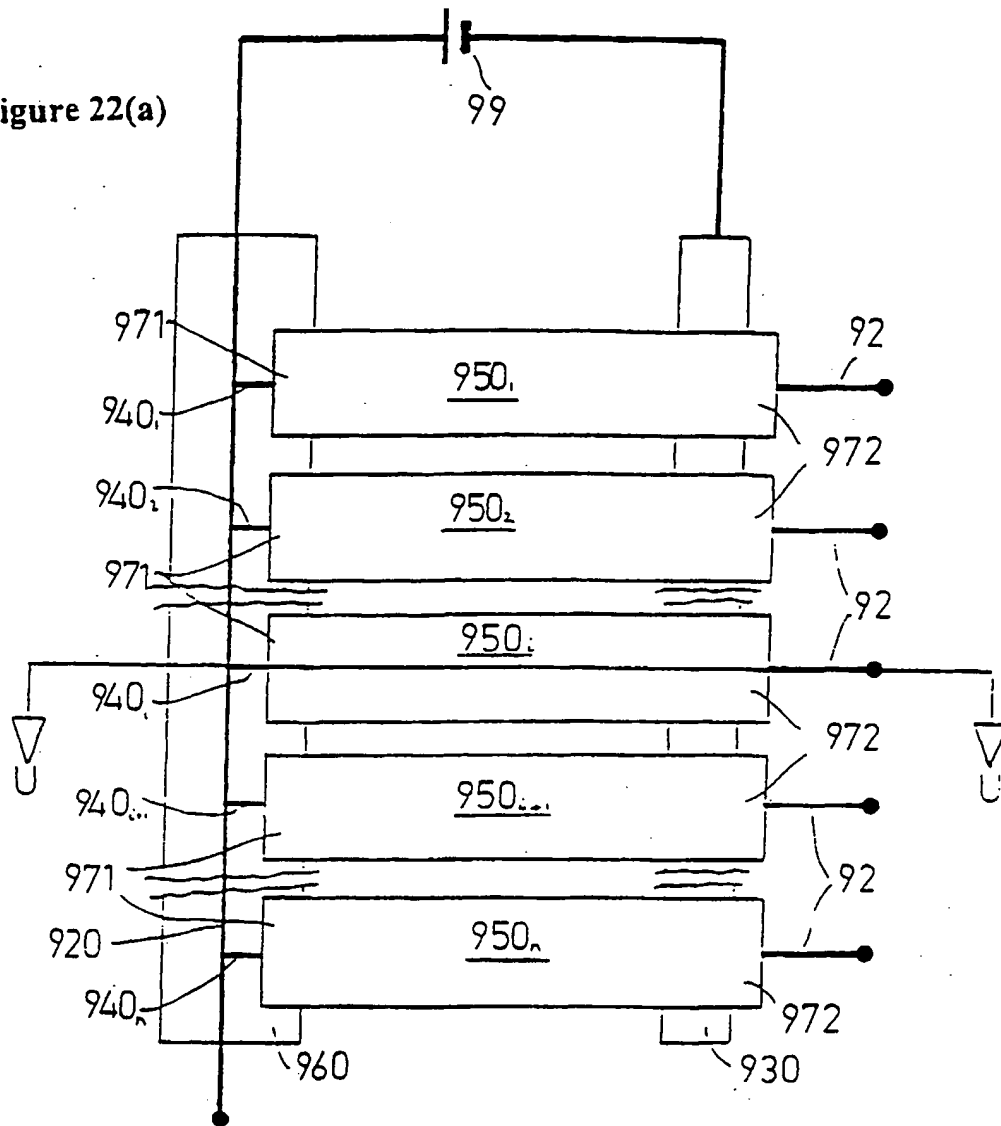


Figure 22(b)

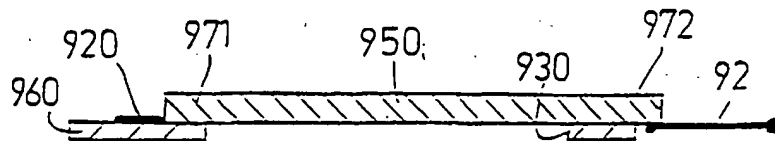


Figure 22(c)

